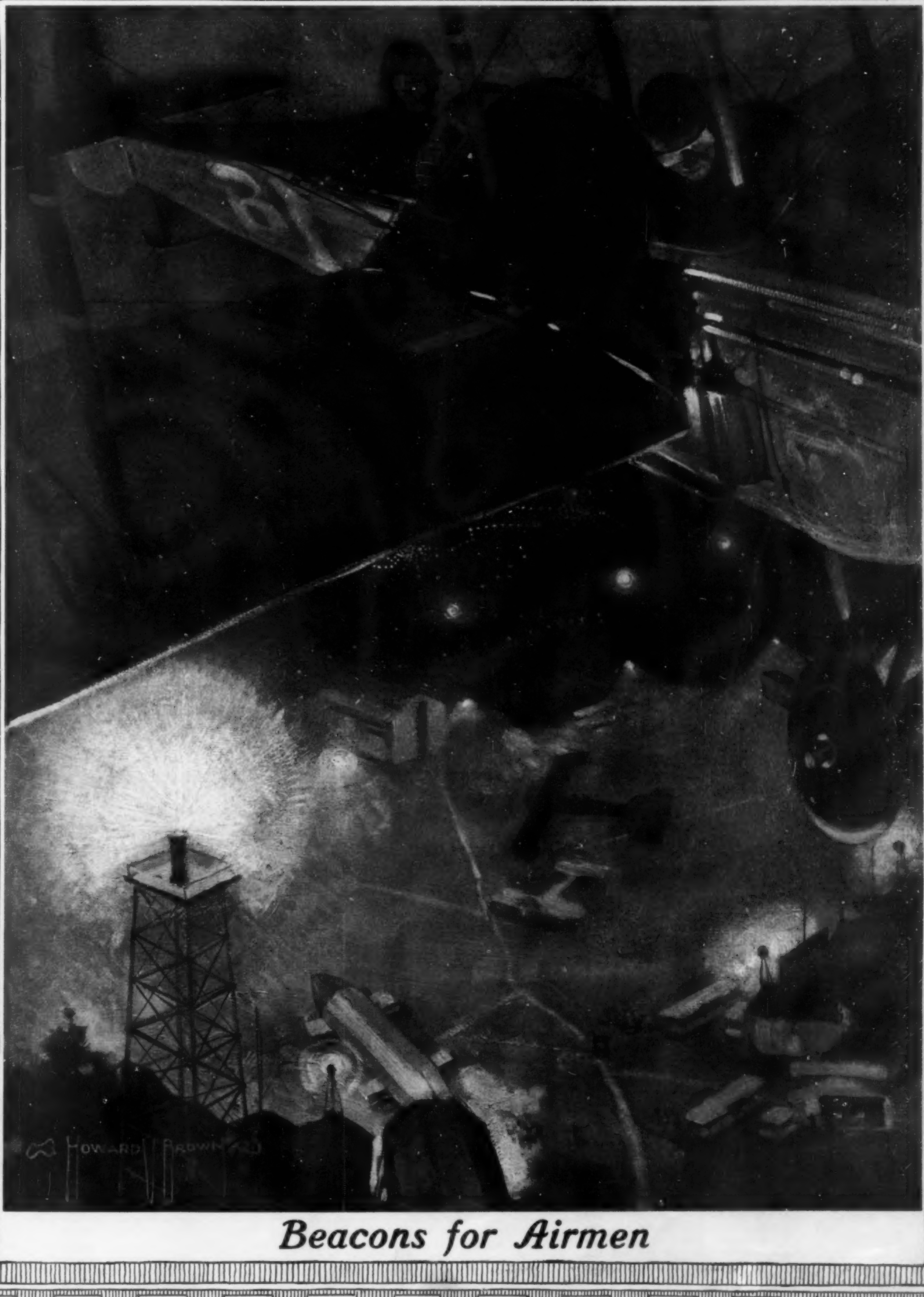
SCIENTIFIC AMERICAN



Beacons for Airmen

Vol. CX. No. 20
May 16, 1914

Munn & Co., Inc., Publishers
New York, N. Y.

Price 10 Cents
$3.00 A Year

A Prize of

$1000.

For the best house of the year

In the interest of better homes *Country Life in America* offers a prize of a thousand dollars, which will be paid to the owner of that house, occupied for the first time within the year 1914, which, in the opinion of the judges, attains the greatest all-around excellence. It is hoped that the award will so justify itself as to cause this offer to be repeated year after year.

CONDITIONS

The house must be a country or suburban home, first occupied between Jan. 1, 1913 and Jan. 1, 1914. It must have cost not less than $5000, exclusive of the land and interior furnishings. It must be a year-round home, completely equipped with heating, plumbing, etc.

BASIS OF AWARD

It is intended that the best house of the year shall win the prize. The cost will not enter into the matter at all, so that a $5000 house will have just as much chance of winning as one costing many times that amount. To this end the entries will be judged on a point system, in which the 100 points representing perfection are divided as follows: plan, 35; exterior appearance, 25; interior equipment and furnishing, 25; setting (by which is meant the arrangement of paths, garden and planting in the immediate surroundings), 15.

ENTRY REQUIREMENTS

The competition is open to any house built on the North American continent conforming to the "conditions" above stated. (The owner need not necessarily be a subscriber to *Country Life in America.*) Each house must be represented to the judges with the following material, which shall be in the hands of the Competition Editor, *Country Life in America*, Garden City, L. I., on or before July 1, 1914: (1)—Plans of first and second floors in black on white paper, drawn to a given scale or dimensioned. (2)—Sketch block plan of house and immediate surroundings. (3)—At least 8 photographs, not smaller than 5 x 7 in., of which not less than three shall be of the exterior, nor less than one each of living-room, dining-room and owner's bedroom. (4)—A typewritten description of about 1000 words, supplementing the photographs and plans and describing materials, color schemes and special points of construction, arrangement and furnishing.

THE JUDGES

Mr. Guy Lowell, architect and landscape architect, of Boston; Mr. Howard Van Doren Shaw, architect, of Chicago, and the Editor of *Country Life in America* will be the judges. These three will designate the winner of the prize and will award honorable mention to such other houses entered as may in their opinion merit it.

$1000 to the owner—a gold medal to the architect

$1000 will be paid to the owner of the house selected as the best of those submitted. A gold medal, suitably engraved, will be awarded the architect of the same house.

Plans, descriptions and photographs entered will be returned only to those enclosing postage or express return charges. The material describing the prize-winning house will become the property of *Country Life in America*. The material describing houses awarded honorable mention may be retained and paid for at the magazine's regular rates.

The prize house and a number of those awarded honorable mention will be published in *Country Life in America*. "The Best House of the Year" appearing in the October (1914) Annual Building Number. Arrangements are now being made to exhibit photographs and plans of the successful houses in several of the larger cities.

Country Life in America

MAIL THIS NOW WITH A DOLLAR BILL

Si. Am. 5-16.

Dear Sirs:
For the enclosed $1 send me *Country Life in America* for 5 months—June to October, inclusive.

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DOUBLEDAY, PAGE & CO.
Garden City New York

Further information regarding the award will be published in *Country Life in America* throughout the summer. You must have these forthcoming issues and the October Building Number with the $1000 Prize House. Sign the coupon and mail it now.

SEVENTIETH YEAR

SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

VOLUME CX.
NUMBER 20.

NEW YORK, MAY 16, 1914

PRICE 10 CENTS
$3.00 A YEAR

Analyzing the Human Singing Voice

UNTIL the present day the nearest approach to accuracy in the gaging of musical tone has been afforded by the human ear. Those interested in the development of their own voices or of the voices of singers or students have been as dependent upon the not altogether faithful and infallible judgment obtained by the individual sense of hearing as the importer or distributor of tea or coffee is dependent upon the verdict of the professional sampler, or taster.

As the sense of taste is seldom exactly the same with two persons, and tea tasters will often be found to disagree as to the flavor and quality of a brand they may be sampling, so the sense of hearing is subject to disagreement—the more so, indeed, because its impressions are of a transitory nature and derived from abstract and not from physical subjects. This is shown by the indefinite terminology used by the voice teachers and critics in their work of vocal tone description. On the other hand, the sense of sight is held to be the most accurate and unfailing, because it has the advantage of a permanent material object that may be deliberately studied and analyzed. It is by far the most discriminating sense we have, and, therefore, impressions received through it are capable of exact description.

Photographic tone analysis is an ultra-modern device of science, which promises to exert a vital influence upon the development of the voice, as, indeed, it may, also, upon the manufacture of musical instruments. It is in the formulation of the theory of correct tone production that the exact analysis of tone by photography has accomplished its most valuable function thus far.

Dr. Floyd S. Muckey of New York city, who was associated with the late William Hallock, professor of physics at Columbia University, in a scientific investigation of the physical laws of the voice which lasted more than twenty years, has evolved a scientific method of voice production, a method which especially takes into consideration the factor of interference with the correct action of the voice mechanism. It is by photographic tone analysis that he specifically sets forth the part which interference plays in preventing the full use of the vocal capabilities. Interference is also shown to be the direct cause in the deterioration of the vocal instrument. He accomplishes his analysis of vocal tones, and, likewise, his analysis of instrumental tones by the use of the Koenig manometric flame analyzer which has been greatly improved for this work by Prof. Hallock.

The photographic "tone analyzer," as the apparatus might more popularly be termed, provides an actual and permanent record of tone quality and shows the definite convention of cause and effect between interference with the mechanism and the resulting tone. How these tone photographs bear out the principles advocated by him is thus outlined by Dr. Muckey:

"The roof of the mouth ends posteriorly in the soft palate, which rises in the act of swallowing to prevent the entrance of food into the cavities of the upper pharynx and nose. If the soft palate is raised during voice production, these important cavities, constituting the larger part of the resonance space, are shut off and the apparatus records the loss of the four highest partial tones, showing a decided reduction in the strength of the pitch, or fundamental, tone. A voice loses more than half its volume, i. e., its intensity and carrying power, by this great loss of resonance space. Any contraction of the muscles (*palato-pharyngei*) of the soft palate attached to the large cartilage of the larynx (*thyroid*) interferes with the pitch mechanism."

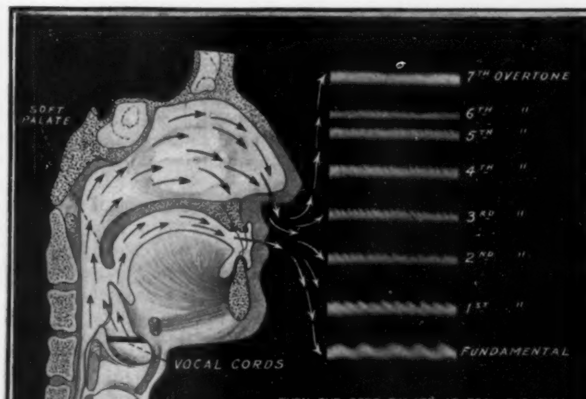
This apparatus photographs, not tone, but the vibratory effect of air-waves from the source of tone-production, as projected through Helmholz spherical resonators, attuned to the fundamental and characteristic overtones, upon tiny jets of gas-flame whose fluctuations are caught by a camera lens. The resulting impression recorded upon the photographic plate is a series of horizontal lines of light picturing the motion of the flames and accurately representing the vibrations of a single string tone, as divided into the fundamental tone and its six or seven overtones. These make up the complex tone of any single tone sounded either by the voice or by a musical instrument of the string family.

"The results of the operation of this apparatus are shown in the accompanying photograph of the vibrations of a vocal tone. The lower C, as produced by the voice mechanism in the vowel "a" (as in "father"), upon the pitch of a standard fork (128 vibrations per second) is given. The number of vibrations that the fundamental tone bears to the rate of its overtones, harmonics, or upper partials, is in the ratio of 1 to 2, 3, 4, 5, 6, etc. Hence, the resonators are attuned to bass C, and its seven overtones, whose rates of vibration and approximate pitches are as follows:

Fundamental,	128	vibrations	per	second,	about	bass C
1st overtone,	256	"	"	"	"	middle C
2nd "	384	"	"	"	"	" G
3rd "	512	"	"	"	"	high C
4th "	640	"	"	"	"	" E
5th "	768	"	"	"	"	" G
6th "	896	"	"	"	"	" B flat
7th "	1,024	"	"	"	"	C in alt.

"The analysis is made so that we may describe each

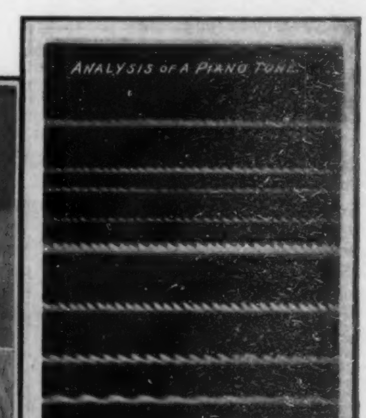
(*Continued on page 421.*)



The effect of correct and incorrect placing of the soft palate is shown by the photographs of tones appearing opposite the mouths. Note that when the full resonance capacity of the nose is used, as in the upper picture, a strong fundamental tone with good overtones is obtained; the lower picture shows how markedly poor is the effect when the soft palate is up. The photographs of the fundamental tones and the corresponding overtones, appearing opposite each drawing of the human head, were obtained by means of the improved Koenig manometric flame apparatus shown in the center engraving on this page. They give instrumental evidence (better than any personal opinion) of the effect which the position of the soft palate has on tone production.

The Koenig manometric flame analyzer consists of a number of Helmholtz resonators connected by tubes with gas jets. As the subject tested sings, the flames vibrate. They are reflected in the vertical mirror, which the operator can turn by hand, so that the vibrating flames are seen as in the photographs on the left hand side of this page. The mirror is not used in making the photographs; a plate holder in a camera is merely shifted laterally during exposure, thus producing the effect shown in our picture. Before the late Prof. Hallock of Columbia University improved the Koenig manometric flame analyzer photographs such as those reproduced on this page could not be made. Experimenters made drawings by watching the reflection of the flames in the mirror. The photographs herewith reproduced are among the first ever obtained by means of the Koenig apparatus.

Analyzing the singing voice.



Tones of the pianoforte and violin, respectively, sounded upon lower C. In the piano record the fundamental tone represented by the first line is weak, but the overtones are highly developed. In the violin record the lower line, being bass C (128 vibrations), records no air-waves, because air-waves of that length were not sounded; the second line is the octave of bass C (256 vibrations) and the fundamental of this set of partials.

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Munn & Co., Inc., 361 Broadway, New York

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

The purpose of this journal is to record accurately, simply, and interestingly, the world's progress in scientific knowledge and industrial achievement.

The All-steel Aeroplane

IT is a curious anomaly that in this age of steel construction such a large amount of wood should be used in the building of aeroplanes. In the sister art of yacht construction wood has been abandoned, except for a few uses, entirely in favor of steel and the high-grade alloys. Why has not a similar substitution been made in the aeroplane, where the demand for weight-saving is scarcely less insistent than it is in the racing yacht?

A few years ago it would have been near the truth to say that this clinging to wood construction was due to conservatism—an unwillingness to change from the familiar to the less familiar. The gliders of the early experimentalists were made of wood and canvas; so was Wilbur Wright's first power-driven machine; and in an art so novel as that of flying, whose votaries, generally speaking, were men possessed of more daring and enthusiasm than they were of technical knowledge, it can readily be understood that there was a disposition to cling to the forms and material, with which Wright made his classic flight at Kitty Hawk.

Wright himself was not free from this prejudice in favor of wood for aeroplane construction. The writer remembers discussing with him at the Belmont Park meeting the subject of the SCIENTIFIC AMERICAN design for an all-steel racing monoplane. Wright acknowledged that the theory of the metal machine was correct; but turning to the "Baby Wright" machine which was standing nearby, he patted one of the wooden struts and voiced a sentiment which is strong, even to-day among aeroplane builders, by saying: "This is the material for the aeroplane; I know what it can do, and it gives some warning of a failure."

Yet, it is a fact which cannot be disputed, that compared on the score of strength for weight, and of reliability, the steel and other alloys are vastly superior to wood, even for such special requirements as those of the aeroplane.

The main transverse spars in the wings of a monoplane are not subjected to any more complicated and severe stresses than is the mast of a racing yacht. The compression in the spars, due to the pull of the guy wires, finds its counterpart in the compression of the mast due to the pull of the shrouds; and the transverse bending stresses, applied to the spars at the wing cross-ribs, find their counterpart in the bending stresses on the mast due to the pull of the mast hoops—yet the yacht designer has not hesitated to abandon the wooden mast and the wooden boom and substitute spars built up of steel.

We note that our esteemed contemporary, *The Engineer* of London, which has long been an earnest advocate, like ourselves, of the substitution of metal for wood in aeroplane construction, ascribes the reluctance to make the change largely to the difficulty of obtaining the shapes which are required for the framing, and particularly for the struts, as used in the biplane. There is no doubt that aeroplane construction calls and will ever call for unusual shapes. But it is certain that, as in the case of the automobile, when once the request for shapes of special metal and special form has become general, there will be a lowering in the price due to the increased demand.

Some Points in Cup Defender Construction

IT is probable that there is no structure built of metal in which the stresses are so complicated, or in which they approach so near to the breaking point, as in the modern steel-and-bronze yacht, and particularly in such yachts as are built for the "America's" cup contest. The hull of such a yacht consists of a steel frame, overlaid with a shell of bronze plating which is not much thicker than the outside cover of a good-sized book. The form of this hull has been calculated with the greatest nicety, and to secure the best speed results, it must, in spite of its fragility, be held true to form—there must be no distortion. The problem of making the yacht at once extremely light and extremely rigid is complicated by the fact that the heavy stresses to which it is subjected tending to distort, if not to pull it apart, are not distributed evenly throughout the boat, but are applied with great intensity at certain points of concentrated stress. Thus, there is the enormous upward pull of the shrouds applied at the side of the boat, and abreast of that the even heavier downward thrust of the mast, tending bodily to burst out the floor of the yacht at that point, and necessitating the construction of a widespread mast-step, to distribute the stress over a large area of the hull.

It is interesting to recall the fact that in the case of the first extremely light metal boat built for the defense of the cup, "Defender," during a knockdown in a squall, this very result of thrusting the mast through the floor came very near happening. The "Defender" was subsequently strengthened at this point by carrying wide steel straps from the foot of the mast to the channels at the junction of deck and side of hull.

As we have said, every conceivable form of stress is applied to a racing yacht. The hull is subjected to severe alternations of compression and tension; and heavy torsional stresses, tending to twist the hull about its longitudinal axis, are applied when the yacht is heeled well down under her press of canvas. In the earlier metal boats the presence of these severe stresses was revealed by the frequency with which a rivet head would snap off, particularly when the yacht was heading into a sea; and it was not unusual under such circumstances for leakage to be quite severe. Indeed, we have heard it stated, and it is quite conceivable, that the inflow of water along the leaking seams, was at the bottom of the "Valkyrie"-"Defender" controversy in the days of Lord Dunraven.

However, with the steady improvement in the quality of materials available for hull construction and for standing and running gear, the yacht designer is, to-day, able to build with exceedingly light scantling. He may edge up very closely to the "factor-of-safety" line, without being harassed with the fear of breakdowns which haunted the designer of ten or fifteen years ago.

The New York County Medical Society and the Press

THE extent to which medical men may participate in the enlightenment of the public through newspapers and magazines has been the subject of discussion within the past few months. In New York city the Medical Society of the county, through its Board of Censors, has delivered a pronunciamento on infractions of the code of professional ethics, and there have been summoned before it physicians and surgeons of standing whose names have figured in popular articles where facts of medical or surgical progress have been obtained with their co-operation or at least their consent. Discipline also has been threatened practitioners who might be guilty of possible or even constructive indiscretions of publicity.

While something may thus have been accomplished toward checking the unwholesome self-advertisement to which many physicians, both great and small, have yielded, there is manifest a reactionary tendency toward suppression of information on medical topics. Every true scientific man must view with approbation the spread of sound and wholesome knowledge of hygiene and disease among people at large. If the New York County Medical Society persists in its present absurd policy it will only hinder the more general popular appreciation of physicians and surgeons as a class; it will withhold from the public a knowledge of scientific achievements and efforts.

That self-seeking practitioners, and not only charlatans and quacks, may acquire undeserved and fictitious newspaper reputation and be able to impose on a credulous public to its manifest detriment is so obvious that the medical profession should protect itself. But such abuses, real or fancied, should be judged solely on their own merits, instead of being connected with the dissemination of proper and correct medical intelligence. Because a reckless reporter has sinned that is no reason why conscientious writers for the press—men who take the trouble to have their writings approved before publication—should not continue to present information in a popular way. Why it is unethical for an American physician to have his name mentioned in the lay press in connection with an authenticated discovery when cable dispatches from Europe describe corresponding achievements of his fellow-workers abroad seems the height of absurdity. So, too, the reticence manifested in regard to work of high merit or promise, which is of deep interest and concern to the public, smacks more of the old high-priest days of science than of the twentieth century. If the laity were to receive authentic, accurate, simply worded information as to progress in medicine, surgery, and hygiene, with the new and essential features emphasized, if safe and sane conclusions as to the future usefulness of new discoveries are drawn, who can question that a much more sympathetic attitude toward medicine would ensue and an appreciation of medical men more nearly approaching that found in Europe would be produced?

In spite of all the harm done by sensational publications there are many periodicals in which the discussion of medical topics could be carried on in a simple, healthful, and beneficent manner. But that is possible only if editors have the co-operation of the medical profession generally, and if their efforts to secure absolute accuracy and reliability are supported in greater part.

To-day scientific medicine depends upon the dictum of no authority whose *ipse dixit* is accepted with awe and reverence almost superstitious. Not the utterance of a man, but the demonstration of scientific truths in the careful regimen of the laboratory convinces in these scientific days. Once a discovery has been announced to the medical profession, once it has withstood the criticism of those competent to judge, it should be authoritatively brought to general attention. Only in this way can the public be interested to the point of rallying intelligently in support of physicians when the community is threatened by restrictive legislation or attempts to lower the standards of qualifications for practice.

From time to time the most promising efforts in scientific and experimental medicine, indicating results of great value, are interfered with by the efforts of zealous anti-vivisectionists and zoophilists with their attempts at legislative suppression or control of animal experimentation. Had those interested in scientific medicine ever properly informed the public of the nature and object of their experiments, even describing the necessary suffering in the few cases where it must occur, instead of permitting the spread of the general, but unfortunate impression that such practices take place only in cloistered seclusion without systematic method or oversight, no hysterical protests would avail against a community convinced of the great benefits resulting from the labors of those engaged in experimental medicine. The SCIENTIFIC AMERICAN holds no brief for newspaper science, sensationalism, or the commercial exploitation of scientific men and methods, but it does protest against any policy that prevents the result of any scientific investigation, medical or otherwise, being kept from the general discussion of people of intelligence in the columns of journals whose responsible editors make every effort to secure accuracy, authenticity, and sanity for their articles. American medical men must learn that only by the widest knowledge of their efforts and work can they gain the public esteem, while it is only through such knowledge that the higher standards they aim at will be not only appreciated, but generally demanded and enforced.

A Notice

FROM time to time we have had occasion to call attention to the fact that the SCIENTIFIC AMERICAN is not connected in any way with the organization entitled, the "Scientific American Compiling Department," engaged in the sale of the Encyclopedia Americana. This notice is published owing to the fact that we frequently receive letters of inquiry in regard to that enterprise, in spite of the notices published in our columns from time to time stating that we are not responsible for any statements that may be made by the above-mentioned company or its *alter ego*, the Americana Company. The history of the case and of the long-drawn-out lawsuit in connection with the matter were explained at some length in the SCIENTIFIC AMERICAN of November 8th, 1913. It is because of the continued use of the name contrary to our wish that we feel constrained to again advise our friends and readers of these facts.

German Machinery Imports and Exports for the Last Year.—During 1913 the machinery importation into Germany from all nations totaled about 100,000 tons, divided as to the principal countries as follows: United States, 40 per cent; Great Britain, 34 per cent; Canada, 7 per cent; Switzerland, 6 per cent, etc. There were imported 38,535 tons of agricultural machines representing 44 per cent; 7,539 tons of tool machines; of steam boilers, 1,476 tons; of railway and street cars, 6,292 tons; and 2,261 tons of motor vehicles.

Engineering

Longest Stretch of Straight Railway.—It is surprising to learn from *The Engineer* that the longest stretch of railway in the world without a curve is said to be in New Zealand, where there is a continuous tangent 136 miles in length. Because of its mountainous character, New Zealand is known to be one of the most difficult countries for the construction of railways. Its lines are full of sharp curves and unusually heavy grades.

Preliminary Trial Trip of "Vaterland."—On her first sea test, which lasted for two days, the new Hamburg-American liner "Vaterland" of 58,000 tons, the largest ship in the world, is reported to have made the high average speed of 25.8 knots per hour, with the high output of 90,000 horse-power from her four turbines. Both her owners and her builders, Messrs. Blohm and Voss, are to be congratulated that the ship has so greatly exceeded her contract speed.

Japanese Dreadnought "Fuso."—If the *Marine Rundschau* is correct in stating that the Japanese super-dreadnought "Fuso" was recently launched with her engines and guns in place, it seems likely that the Japanese navy will be the first to have a battleship in commission carrying twelve 14-inch guns. This ship is of about 30,000 tons displacement, and she will have a secondary battery of sixteen 6-inch rapid fire guns. She is down for completion in July, 1915, and a sister ship, also building in Japan, is due to be completed a year later.

Population and Traffic Problem.—Great as is the scale upon which the New York subways are being enlarged, it must be admitted that the recent census statistics indicate that the system will be in urgent demand long before it is finished. Figures given out recently from the census office show that on July 1st of this year New York's population will be about 5,333,537 people, which represents a gain in four years of 556,664. This means that the city, large as it is, is now adding to its numbers every year some 140,000 souls, which is the population of a large city.

Hydraulic Grader for Culebra Cut.—A hydraulic grader for smoothing down the slopes of the Culebra Cut has been constructed for the Isthmian Canal Commission. The grader is an arrangement of high-pressure boilers and pumps, which will pump water from alongside the vessel and deliver it at high pressure to pipe lines or hose for sluicing material down at the banks of the canal. This is the kind of work that is being done at Cucuracha slide by pipe-line suction dredge No. 82, which is pumping to two monitors at a discharge pressure of 45 to 50 pounds. The new graders will deliver at a pressure of 225 to 235 pounds to the square inch, discharging through a three-inch hose at an elevation of 50 feet above the water-line.

Large Turbine Air Compressors.—By utilizing the energy of rapidly-rotating bladed wheels it is now possible to compress air on the turbine principle to much better advantage, it is claimed, than with piston machines. The rotary type, such as is constructed at the Berlin Allgemeine Works, now goes as high as 3,000,000 cubic feet an hour and compresses to 10 or 12 atmospheres, taking about 12,000 horse-power in a single machine. A special steam turbine is coupled to three separate rotary air compressors. Between each compressor is a cooler for lowering the temperature of the air. The Victoria Falls and Transvaal Power Company appears to be the first to take advantage of the large-unit construction afforded by the present type, and is installing a large plant for power transmission by compressed air, having already in the central stations near Johannesburg as many as 12 turbo-compressors of 4,000 horse-power size. Air is sent in 20 miles of pipe to 17 mines for drills and other uses. With the three new 12,000 horse-power sets which are to be put in, the total will be 84,000 horse-power transmitted to the mines.

City Takes Title to Steinway Tube.—Title to the Steinway tunnel, which has been the source of much litigation for years, passed to the city recently. The deed was received by the Mayor from the Interborough Rapid Transit Company, which acquired it some years ago through the absorption of the company owning it. The litigation was as to whether, the franchise for the tunnel having expired, the company would be able to operate it by reason of special legislation. The city won and the company decided to turn the tube over to the city for $3,000,000. The cost was in the neighborhood of $8,000,000. The tunnel is to be a part of the dual rapid transit system, and the Interborough will be credited with $3,000,000 as its share in its participation in the entire system. The Board of Estimate approved the contract with the Rapid Transit Construction Company for the completion of the tunnel for temporary operation, pending the completion of the dual system. Work will be started soon. The tunnel runs from the vicinity of the Grand Central Station in Manhattan to Fourth Street in Long Island City.

Electricity

Wireless Telephony from Brussels to Paris.—The London *Times* reports that on March 29th a tenor singing in a concert at Laeken, near Brussels, was heard by wireless telephony on the Eiffel Tower, in Paris. The distance between the two places is 225 miles. Use was made in this experiment of a new microphone invented by the Italian engineer Marzi.

A Railway from Limbach to Mittweida is one of the most recent electric lines in Germany, and is designed to connect these industrial towns and also Burgstädt, taking in many smaller localities, so that the present region of Saxony will have better communication than before. The line is 15 miles long and is fed by the Oberlungwitz electric station. An overhead trolley line working at 1,000 volts supplies the cars, each of which carries two motors of 50 horse-power. Freight as well as passengers is carried on the trains, and there is already a good traffic assured. It makes connection with the state railroad which crosses the electric line at two points.

A Novel Advertising Device has made its appearance, which consists of a polished metal cylinder shaped like a vase. Inside the receptacle is a small electric motor which makes a magnet turn about a shaft. Small articles for sale with pieces of iron imbedded in them are put on the cylinder, and the magnet causes them to travel around the surface. This movement attracts the attention of the passers-by, and still further attraction is caused by employing small figures of men or others of an amusing character which go through irregular evolutions around the cylinder. Small steel balls with flags stuck in them are found among the best for this use.

Electrical Iron and Steel Production in Sweden has been on the increase within a recent period. As to the amount turned out in that country, starting with 122 tons in 1908, it rose to 870 tons in 1910 and 18,000 tons in 1912, or the last report. There are upwards of 20 electric furnaces running at present, using in all some 60,000 horse-power. New furnaces are building at Lofoten, Gelivara and Sandviken. The Stora Kopparbergs Company recently purchased a waterfall which gives 150,000 horse-power, and is to build new furnaces in the near future. As regards chrome steel, a new plant was put in use not long ago at Trolhattan with two electric furnaces, which reduce ore imported from New Caledonia and South Africa, using the three-phase system. The product contains from 5 to 9 per cent chromium, and is furnished in four different grades.

The Failure of "Hail-Rods" in France.—Reference has been made several times in these columns to the recent erection in many parts of France of large lightning-rods, known as "electric Niagaras," supposed to be efficacious in averting hailstorms. The futility of such devices seems obvious to persons familiar with the mechanism of thunderstorms, of which hail is merely a by-product, yet hundreds of the rods have been installed at great expense. In a recent communication to the National Society of Agriculture of France, Prof. Alfred Angot, director of the French meteorological service, after pointing out the absurdity of the "Niagaras" from a scientific point of view, cited a number of instances in which the rods had signally failed of their purpose. Thus, the large rod installed on the Eiffel Tower has not had any effect on the frequency of hail in its vicinity. In the suburbs of Clermont-Ferrand a big "Niagara" stands on an iron tower 100 feet high. This rod was itself pelted with hail twice in 1912 and four times in 1913; in one storm some of the hailstones attained the size of hen's eggs. Similar cases have been reported from other parts of France.

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The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

The purpose of this journal is to record accurately, simply, and interestingly, the world's progress in scientific knowledge and industrial achievement.

The All-steel Aeroplane

IT is a curious anomaly that in this age of steel construction such a large amount of wood should be used in the building of aeroplanes. In the sister art of yacht construction wood has been abandoned, except for a few uses, entirely in favor of steel and the high-grade alloys. Why has not a similar substitution been made in the aeroplane, where the demand for weight-saving is scarcely less insistent than it is in the racing yacht?

A few years ago it would have been near the truth to say that this clinging to wood construction was due to conservatism—an unwillingness to change from the familiar to the less familiar. The gliders of the early experimentalists were made of wood and canvas; so was Wilbur Wright's first power-driven machine; and in an art so novel as that of flying, whose votaries, generally speaking, were men possessed of more daring and enthusiasm than they were of technical knowledge, it can readily be understood that there was a disposition to cling to the forms and material, with which Wright made his classic flight at Kitty Hawk.

Wright himself was not free from this prejudice in favor of wood for aeroplane construction. The writer remembers discussing with him at the Belmont Park meeting the subject of the SCIENTIFIC AMERICAN design for an all-steel racing monoplane. Wright acknowledged that the theory of the metal machine was correct; but turning to the "Baby Wright" machine which was standing nearby, he patted one of the wooden struts and voiced a sentiment which is strong, even to-day among aeroplane builders, by saying: "This is the material for the aeroplane; I know what it can do, and it gives some warning of a failure."

Yet, it is a fact which cannot be disputed, that compared on the score of strength for weight, and of reliability, the steel and other alloys are vastly superior to wood, even for such special requirements as those of the aeroplane.

The main transverse spars in the wings of a monoplane are not subjected to any more complicated and severe stresses than is the mast of a racing yacht. The compression in the spars, due to the pull of the guy wires, finds its counterpart in the compression of the mast due to the pull of the shrouds; and the transverse bending stresses, applied to the spars at the wing cross-ribs, find their counterpart in the bending stresses on the mast due to the pull of the mast hoops—yet the yacht designer has not hesitated to abandon the wooden mast and the wooden boom and substitute spars built up of steel.

We note that our esteemed contemporary, *The Engineer* of London, which has long been an earnest advocate, like ourselves, of the substitution of metal for wood in aeroplane construction, ascribes the reluctance to make the change largely to the difficulty of obtaining the shapes which are required for the framing, and particularly for the struts, as used in the biplane. There is no doubt that aeroplane construction calls and will ever call for unusual shapes. But it is certain that, as in the case of the automobile, when once the request for shapes of special metal and special form has become general, there will be a lowering in the price due to the increased demand.

Some Points in Cup Defender Construction

IT is probable that there is no structure built of metal in which the stresses are so complicated, or in which they approach so near to the breaking point, as in the modern steel-and-bronze yacht, and particularly in such yachts as are built for the "America's" cup contest. The hull of such a yacht consists of a steel frame, overlaid with a shell of bronze plating which is not much thicker than the outside cover of a good-sized book. The form of this hull has been calculated with the greatest nicety, and to secure the best speed results, it must, in spite of its fragility, be held true to form—there must be no distortion. The problem of making the yacht at once extremely light and extremely rigid is complicated by the fact that the heavy stresses to which it is subjected tending to distort, if not to pull it apart, are not distributed evenly throughout the boat, but are applied with great intensity at certain points of concentrated stress. Thus, there is the enormous upward pull of the shrouds applied at the side of the boat, and abreast of that the even heavier downward thrust of the mast, tending bodily to burst out the floor of the yacht at that point, and necessitating the construction of a widespread mast-step, to distribute the stress over a large area of the hull.

It is interesting to recall the fact that in the case of the first extremely light metal boat built for the defense of the cup, "Defender," during a knockdown in a squall, this very result of thrusting the mast through the floor came very near happening. The "Defender" was subsequently strengthened at this point by carrying wide steel straps from the foot of the mast to the channels at the junction of deck and side of hull.

As we have said, every conceivable form of stress is applied to a racing yacht. The hull is subjected to severe alternations of compression and tension; and heavy torsional stresses, tending to twist the hull about its longitudinal axis, are applied when the yacht is heeled well down under her press of canvas. In the earlier metal boats the presence of these severe stresses was revealed by the frequency with which a rivet head would snap off, particularly when the yacht was heading into a sea; and it was not unusual under such circumstances for leakage to be quite severe. Indeed, we have heard it stated, and it is quite conceivable, that the inflow of water along the leaking seams, was at the bottom of the "Valkyrie"-"Defender" controversy in the days of Lord Dunraven.

However, with the steady improvement in the quality of materials available for hull construction and for standing and running gear, the yacht designer is, to-day, able to build with exceedingly light scantling. He may edge up very closely to the "factor-of-safety" line, without being harassed with the fear of breakdowns which haunted the designer of ten or fifteen years ago.

The New York County Medical Society and the Press

THE extent to which medical men may participate in the enlightenment of the public through newspapers and magazines has been the subject of discussion within the past few months. In New York city the Medical Society of the county, through its Board of Censors, has delivered a pronunciamento on infractions of the code of professional ethics, and there have been summoned before it physicians and surgeons of standing whose names have figured in popular articles where facts of medical or surgical progress have been obtained with their co-operation or at least their consent. Discipline also has been threatened practitioners who might be guilty of possible or even constructive indiscretions of publicity.

While something may thus have been accomplished toward checking the unwholesome self-advertisement to which many physicians, both great and small, have yielded, there is manifest a reactionary tendency toward suppression of information on medical topics. Every true scientific man must view with approbation the spread of sound and wholesome knowledge of hygiene and disease among people at large. If the New York County Medical Society persists in its present absurd policy it will only hinder the more general popular appreciation of physicians and surgeons as a class; it will withhold from the public a knowledge of scientific achievements and efforts.

That self-seeking practitioners, and not only charlatans and quacks, may acquire undeserved and fictitious newspaper reputation and be able to impose on a credulous public to its manifest detriment is so obvious that the medical profession should protect itself. But such abuses, real or fancied, should be judged solely on their own merits, instead of being connected with the dissemination of proper and correct medical intelligence. Because a reckless reporter has sinned that is no reason why conscientious writers for the press—men who take the trouble to have their writings approved before publication—should not continue to present information in a popular way. Why it is unethical for an American physician to have his name mentioned in the lay press in connection with an authenticated discovery when cable dispatches from Europe describe corresponding achievements of his fellow-workers abroad seems the height of absurdity. So, too, the reticence manifested in regard to work of high merit or promise, which is of deep interest and concern to the public, smacks more of the old high-priest days of science than of the twentieth century. If the laity were to receive authentic, accurate, simply worded information as to progress in medicine, surgery, and hygiene, with the new and essential features emphasized, if safe and sane conclusions as to the future usefulness of new discoveries are drawn, who can question that a much more sympathetic attitude toward medicine would ensue and an appreciation of medical men more nearly approaching that found in Europe would be produced?

In spite of all the harm done by sensational publications there are many periodicals in which the discussion of medical topics could be carried on in a simple, healthful, and beneficent manner. But that is possible only if editors have the co-operation of the medical profession generally, and if their efforts to secure absolute accuracy and reliability are supported in greater part.

To-day scientific medicine depends upon the dictum of no authority whose *ipse dixit* is accepted with awe and reverence almost superstitious. Not the utterance of a man, but the demonstration of scientific truths in the careful regimen of the laboratory convinces in these scientific days. Once a discovery has been announced to the medical profession, once it has withstood the criticism of those competent to judge, it should be authoritatively brought to general attention. Only in this way can the public be interested to the point of rallying intelligently in support of physicians when the community is threatened by restrictive legislation or attempts to lower the standards of qualifications for practice.

From time to time the most promising efforts in scientific and experimental medicine, indicating results of great value, are interfered with by the efforts of zealous anti-vivisectionists and zoophilists with their attempts at legislative suppression or control of animal experimentation. Had those interested in scientific medicine ever properly informed the public of the nature and object of their experiments, even describing the necessary suffering in the few cases where it must occur, instead of permitting the spread of the general, but unfortunate impression that such practices take place only in cloistered seclusion without systematic method or oversight, no hysterical protests would avail against a community convinced of the great benefits resulting from the labors of those engaged in experimental medicine. The SCIENTIFIC AMERICAN holds no brief for newspaper science, sensationalism, or the commercial exploitation of scientific men and methods, but it does protest against any policy that prevents the result of any scientific investigation, medical or otherwise, being kept from the general discussion of people of intelligence in the columns of journals whose responsible editors make every effort to secure accuracy, authenticity, and sanity for their articles. American medical men must learn that only by the widest knowledge of their efforts and work can they gain the public esteem, while it is only through such knowledge that the higher standards they aim at will be not only appreciated, but generally demanded and enforced.

A Notice

FROM time to time we have had occasion to call attention to the fact that the SCIENTIFIC AMERICAN is not connected in any way with the organization entitled, the "Scientific American Compiling Department," engaged in the sale of the Encyclopedia Americana. This notice is published owing to the fact that we frequently receive letters of inquiry in regard to that enterprise, in spite of the notices published in our columns from time to time stating that we are not responsible for any statements that may be made by the above-mentioned company or its *alter ego*, the Americana Company. The history of the case and of the long-drawn-out lawsuit in connection with the matter were explained at some length in the SCIENTIFIC AMERICAN of November 8th, 1913. It is because of the continued use of the name contrary to our wish that we feel constrained to again advise our friends and readers of these facts.

German Machinery Imports and Exports for the Last Year.—During 1913 the machinery importation into Germany from all nations totaled about 100,000 tons, divided as to the principal countries as follows: United States, 40 per cent; Great Britain, 34 per cent; Canada, 7 per cent; Switzerland, 6 per cent, etc. There were imported 38,535 tons of agricultural machines representing 44 per cent; 7,539 tons of tool machines; of steam boilers, 1,476 tons; of railway and street cars, 6,292 tons: and 2,261 tons of motor vehicles.

Engineering

Longest Stretch of Straight Railway.—It is surprising to learn from *The Engineer* that the longest stretch of railway in the world without a curve is said to be in New Zealand, where there is a continuous tangent 136 miles in length. Because of its mountainous character, New Zealand is known to be one of the most difficult countries for the construction of railways. Its lines are full of sharp curves and unusually heavy grades.

Preliminary Trial Trip of "Vaterland."—On her first sea test, which lasted for two days, the new Hamburg-American liner "Vaterland" of 58,000 tons, the largest ship in the world, is reported to have made the high average speed of 25.8 knots per hour, with the high output of 90,000 horse-power from her four turbines. Both her owners and her builders, Messrs. Blohm and Voss, are to be congratulated that the ship has so greatly exceeded her contract speed.

Japanese Dreadnought "Fuso."—If the *Marine Rundschau* is correct in stating that the Japanese super-dreadnought "Fuso" was recently launched with her engines and guns in place, it seems likely that the Japanese navy will be the first to have a battleship in commission carrying twelve 14-inch guns. This ship is of about 30,000 tons displacement, and she will have a secondary battery of sixteen 6-inch rapid fire guns. She is down for completion in July, 1915, and a sister ship, also building in Japan, is due to be completed a year later.

Population and Traffic Problem.—Great as is the scale upon which the New York subways are being enlarged, it must be admitted that the recent census statistics indicate that the system will be in urgent demand long before it is finished. Figures given out recently from the census office show that on July 1st of this year New York's population will be about 5,333,537 people, which represents a gain in four years of 556,664. This means that the city, large as it is, is now adding to its numbers every year some 140,000 souls, which is the population of a large city.

Hydraulic Grader for Culebra Cut.—A hydraulic grader for smoothing down the slopes of the Culebra Cut has been constructed for the Isthmian Canal Commission. The grader is an arrangement of high-pressure boilers and pumps, which will pump water from alongside the vessel and deliver it at high pressure to pipe lines or hose for sluicing material down at the banks of the canal. This is the kind of work that is being done at Cucuracha slide by pipe-line suction dredge No. 82, which is pumping to two monitors at a discharge pressure of 45 to 50 pounds. The new graders will deliver at a pressure of 225 to 235 pounds to the square inch, discharging through a three-inch hose at an elevation of 50 feet above the water-line.

Large Turbine Air Compressors.—By utilizing the energy of rapidly-rotating bladed wheels it is now possible to compress air on the turbine principle to much better advantage, it is claimed, than with piston machines. The rotary type, such as is constructed at the Berlin Allgemeine Works, now goes as high as 3,000,000 cubic feet an hour and compresses to 10 or 12 atmospheres, taking about 12,000 horse-power in a single machine. A special steam turbine is coupled to three separate rotary air compressors. Between each compressor is a cooler for lowering the temperature of the air. The Victoria Falls and Transvaal Power Company appears to be the first to take advantage of the large-unit construction afforded by the present type, and is installing a large plant for power transmission by compressed air, having already in the central stations near Johannesburg as many as 12 turbo-compressors of 4,000 horse-power size. Air is sent in 20 miles of pipe to 17 mines for drills and other uses. With the three new 12,000 horse-power sets which are to be put in, the total will be 84,000 horse-power transmitted to the mines.

City Takes Title to Steinway Tube.—Title to the Steinway tunnel, which has been the source of much litigation for years, passed to the city recently. The deed was received by the Mayor from the Interborough Rapid Transit Company, which acquired it some years ago through the absorption of the company owning it. The litigation was as to whether, the franchise for the tunnel having expired, the company would be able to operate it by reason of special legislation. The city won and the company decided to turn the tube over to the city for $3,000,000. The cost was in the neighborhood of $8,000,000. The tunnel is to be a part of the dual rapid transit system, and the Interborough will be credited with $3,000,000 as its share in its participation in the entire system. The Board of Estimate approved the contract with the Rapid Transit Construction Company for the completion of the tunnel for temporary operation, pending the completion of the dual system. Work will be started soon. The tunnel runs from the vicinity of the Grand Central Station in Manhattan to Fourth Street in Long Island City.

Electricity

Wireless Telephony from Brussels to Paris.—The London *Times* reports that on March 29th a tenor singing in a concert at Laeken, near Brussels, was heard by wireless telephony on the Eiffel Tower, in Paris. The distance between the two places is 225 miles. Use was made in this experiment of a new microphone invented by the Italian engineer Marzi.

A Railway from Limbach to Mittweida is one of the most recent electric lines in Germany, and is designed to connect these industrial towns and also Burgstädt, taking in many smaller localities, so that the present region of Saxony will have better communication than before. The line is 15 miles long and is fed by the Oberlungwitz electric station. An overhead trolley line working at 1,000 volts supplies the cars, each of which carries two motors of 50 horse-power. Freight as well as passengers is carried on the trains, and there is already a good traffic assured. It makes connection with the state railroad which crosses the electric line at two points.

A Novel Advertising Device has made its appearance, which consists of a polished metal cylinder shaped like a vase. Inside the receptacle is a small electric motor which makes a magnet turn about a shaft. Small articles for sale with pieces of iron imbedded in them are put on the cylinder, and the magnet causes them to travel around the surface. This movement attracts the attention of the passers-by, and still further attraction is caused by employing small figures of men or others of an amusing character which go through irregular evolutions around the cylinder. Small steel balls with flags stuck in them are found among the best for this use.

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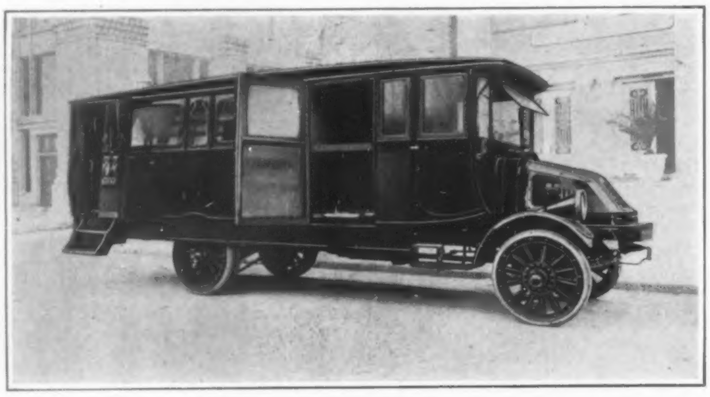
Some Interesting Automobile Novelties

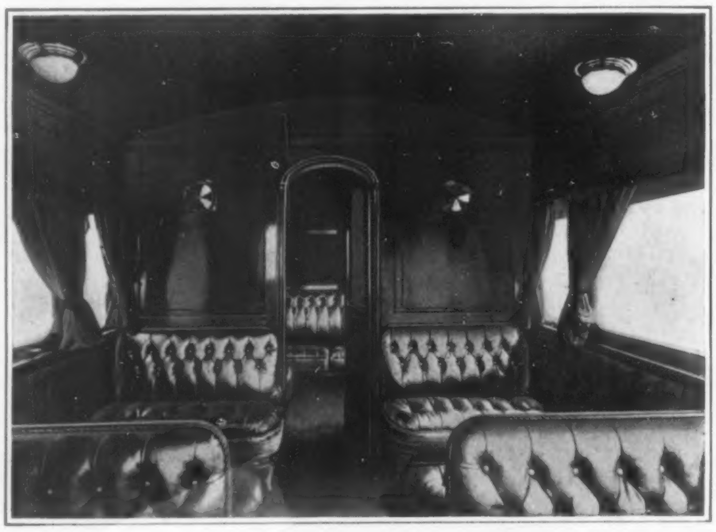
A Funeral Motor Car

A SAN FRANCISCO undertaker has built a funeral car that is far more than a hearse, for, in addition to the space for the casket and flowers, there are accommodations for thirty-seven people.

A single vehicle, therefore, may take the place of a whole funeral train. The car is built on a five-ton standard truck chassis. The woodwork is solid mahogany and it is upholstered with 8-inch morocco leather cushions. It is fitted with electric lights and fans, and rivals a parlor car in comfort and elegance. The car is 30 feet long, 10 feet wide, and 18 feet high. In order that it may be able to make the sharp turns in the aisles of the cemeteries, the wheels are cut under.



Funeral motor car with compartment for the casket and seats for 37 passengers.



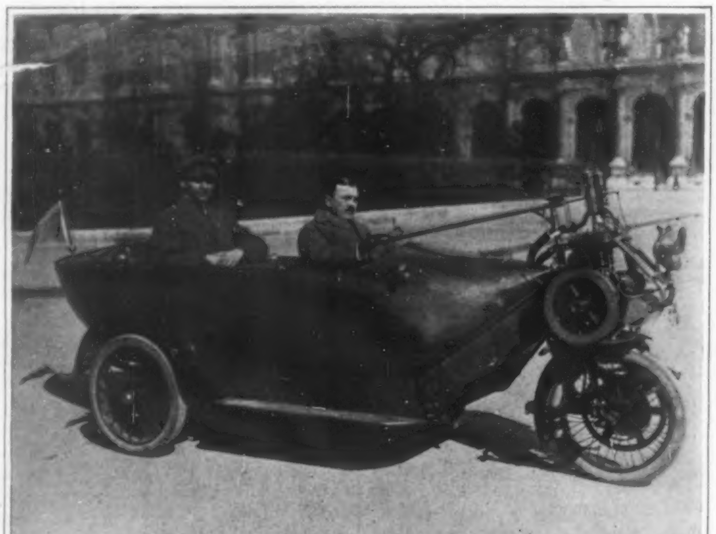
Interior of the car, showing the mourners' section.

The Army Automobile in Service

AN armored automobile was lately given some actual work in operations in Morocco, this belonging to the Spanish army. The present car is provided with an especially thick plating, and it covers the whole of a large power car so as to give it the appearance of a square van. Steel plate is used which is said to be proof against usual bullets. The new car is a veritable traveling fortress, and is divided into three parts, the front for the driver, the middle part, which contains the firing outfit and has slit windows with flaps, and the back portion, fitted out as an ammunition hold. On the top of the car are double flap doors which open nearly the entire roof in order to give an outlook, and there are small side windows also placed near the roof for lookout purposes. The main lookout window is in the front end of the car, and above the driver's seat.

The Auto Skiff

FROM the very earliest days of boat building it was realized that the body of a vessel must be shaped to cut through the water readily; but with the design of vehicles on land little thought was given to air resistance until very recently, when our high-speed machines have shown us that air resistance is an important factor. We are beginning to realize that fuel costs may be kept down if our automobiles are designed to plow through the air with a minimum of head and skin friction. More attention has been paid to this abroad than in this country. Automobile bodies are growing more and more like boats. Logically, the smaller the engine the more necessary it is to pay attention to streamlines in the car body. The accompanying photograph shows a small foreign car which is so boatlike that it even carries a short mast and flag at the stern. Great care has been taken to maintain the lines of the body undisturbed. The steps are kept wholly unencumbered. The tool chest and extra shoes and tires are inclosed in a compartment in the rear. With the motor mounted directly above the single front wheel, weight is reduced to a minimum, and the car is capable of attaining very high speed.



Three-wheeled motor car with boat-shaped body.

A Small Diesel Engine

NUMEROUS attempts have been made to produce an oil engine on the Diesel principle, but of small size, such as is demanded for common use, especially for small dynamo groups, but up to the present time the problem seemed to be unsolved. While it is true that the gasoline motor has come into good use for this purpose, its application is limited owing to the cost of fuel, and also danger from fire. Another type of motor using the incandescent tube ignition operates on the same economical fuel as the Diesel engine, but it consumes much more fuel, and the engine is larger and heavier than the Diesel, besides having other disadvantages. Recently the well-known Berlin Allgemeine works has produced a small motor for use with dynamos, ranging from 60 to 200 horse-power sizes. Economy in fuel consumption, good governing within wide limits, and excellent combustion, as shown by the quality of exhaust gas, is secured in the new engine when using a compression of 30 to 40 atmospheres. It employs a special air compressor which furnishes 60 atmospheres for the motor starting and for injecting of combustible. An oil pump supplies the proper quantities of oil at each interval, working in connection with an atomizing valve. Another point is the starting by means of compressed air. All the parts are designed so as to be easily operated by ordinary personnel. Small groups of this kind have an all-inclosed dynamo mounted on one side of the motor, and this gives a compact makeup. Compressed air comes from a small pump on the motor, and air is stored up in a cylinder in the base, the oil tank being also lodged here. The present engines run at 500 revolutions per minute. On the whole the present makeup is likely to give a wider scope for the use of the Diesel engine, especially for electric groups.

Motor Car for Transporting Horses

EDMOND BLANC of Monaco, a well-known sportsman, has found that his horses suffered on the journey from the stables in England to the Riviera and return, because of the frequent transfer from railway car to boat, and from boat to car. This had the effect of rendering them nervous, and their performances at the race track were not up to par. The necessity of devising some means of transporting the animals without changing cars was evident. This led to the design of the portable stable shown in the accompanying photograph. It consists of a motor truck body, which may be lifted off the chassis and put aboard a train or a boat as the case may be, without disturbing the horse inside. The interior of the car, as shown in one of the photographs, is well padded inside to protect the horse against injury, and the sides are fitted with shutters to provide ventilation. The horse does not feel the fatigue of travel so long as he does not have to leave his stable.

Motor car for transporting horses.

Padded interior of the car.

Lifting the "stable" off the chassis.

Lighthouses for the Aerial Navigator

Guiding the Airman at Night

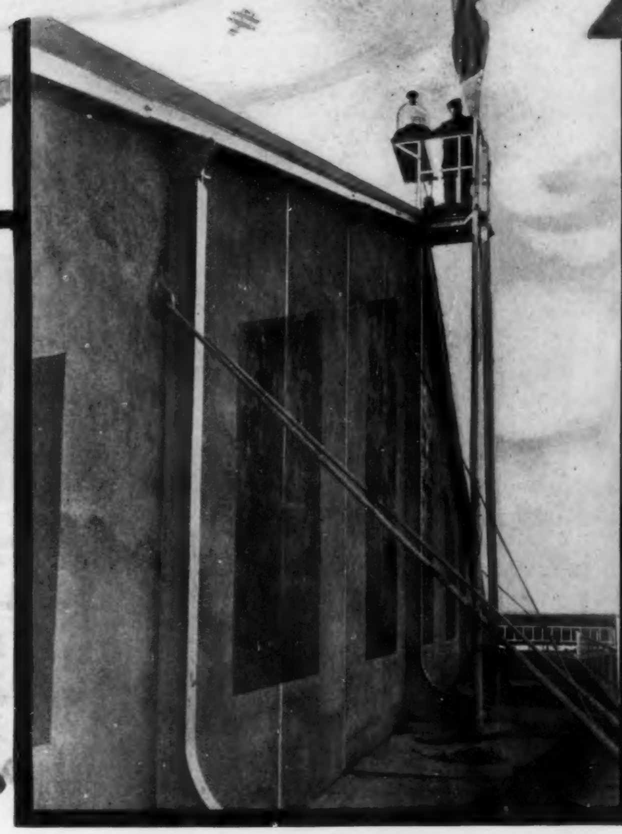
By Dr. Alfred Gradenwitz

Electrical beacon for guiding airmen at night.

The beacon used at Johannistal near Berlin, to guide aerial navigators at night.

Portable military gas beacon.

Light signal known as mark 45.



The beacon used at Potsdam.

Light signal known as mark 123.

A lighthouse for the Johannistal airmen.

Light signal known as mark 1242.

THE use of fires to inform the navigator at dark and in foggy weather of the proximity of the coast and of his actual position can be dated back to the days of Grecian antiquity. In ancient times torches were lighted or heaps of logs burnt, but our inventive age has produced beacons in which the rays from various sources of light are reinforced by mirrors and lenses. These beacons, in accordance with the rapid strides made by navigation, have lately been developed to extraordinary perfection and variety.

The airman requires a similar means to find his way in the atmospheric ocean as navigators at sea. Whereas the light from beacons in the sea need be seen only in a practically horizontal direction, lights for aerial navigation must so give out their beams as to be visible from any point of space situated above the lowest flying level.

A Berlin firm has for some years been engaged in experimental work destined to produce special types of searchlight for aerial navigation. The first type of aerial beacon which they evolved was a stationary apparatus radiating freely in an upward direction beams of light coming from the upper hemisphere, whereas the beams from the lower hemisphere were deflected in a practically horizontal direction by a set of prisms. The type eventually developed, however, comprises several belts of lenses, sending out uniformly in all directions the beams of a lamp placed in the focus.

A point was made from the outset so to design these intermittent beacons as to allow each place to be distinguished from any other by some characteristic mark. Each aerial beacon must have a distinctive mark of its own, this being the only means of reducing the risk of the aeronaut's losing his way. Such marks are made up of variable successions of light flashes denoting given figures.

These characteristic flashes enable the aeronaut with the aid of his log-book, at a moment's notice to ascertain the place where the beacon is situated. Other methods of characterizing the place, e. g., by a sequence of long and short flashes, in accordance with the Morse alphabet, or by multicolored lanterns, would not seem to be desirable. In fact, the use of the Morse signs would presuppose a perfect familiarity with the Morse alphabet, and the adoption of colored lights would be impracticable on account of the considerable reduction in luminous intensity due to the insertion of colored glasses.

The aerial beacons here illustrated are designed to emit an unlimited sequence of flashes of sufficient luminous intensity. Electric incandescent lamps or gas (e. g., acetylene or Blau gas) lanterns are used as sources of light. One of our pictures shows an electric searchlight comprising special lamps (of up to 50,000 candle-power) surrounded by a lens system which is so designed that the beams of light in clear weather are visible up to 40 kilometers as a minimum. A glass globe covers the lenses on the top, a discharge hood serving to prevent excessive heating in the interior of the lamp.

The distinctive flashes previously referred to are produced by a special switch. In flashing the beacons for aerial navigation, the end signal is of great importance. While marking flashes of one and one half seconds as a maximum have been found to be absolutely sufficient, a light of about five seconds' duration is desirable for the end signal.

Wherever electrical energy is available, the use of electric searchlights will be found preferable, whereas on mountain tops and close to the seacoast, where there is no supply of electricity, gas-operated beacons are used to advantage.

Rotating beacons have also been constructed, which combine the beams of light in a bundle seen as a narrow luminous band reaching from the horizon to the zenith. In order to be seen from all points of space, this band must be given a rotation round its axis. Since the whole radiation given out from the lamp is crowded into a relatively small space, the luminous intensity of

rotary searchlights is much greater than that of belt-lens beacons, and may amount to many millions of candle-power.

These searchlights will not only warrant a safe flight to the airman's destination on the shortest possible way, but will prevent his crossing the frontier or the sea-coast.

Has the Fighting Dirigible Airship Arrived?

By Carl Dienstbach

THE veil has at last been lifted from some of the German army and navy preparations for real war in the air. It appears that the largest type of dirigible is now actually at that stage of its development in which its importance as a long range scout is well nigh equaled by its ability to fight. Far from showing its nose only where none of the dreaded armed aeroplanes are at large, its actual rôle in the battles of the future may well be expected to consist in blocking the air to aeroplanes just where free passage would be indispensable for efficient scouting.

The dirigible's comparative slowness would no more prevent it from protecting the secrets of a locality than, for instance, the comparative slowness of dreadnoughts would prevent them from protecting a sluggish fleet of transports against the torpedoes of swift destroyers.

Keeping the "inner circle" and able to perceive the approach of aeroplanes at a score of miles distance, it would need no racing speed to intercept them from any angle with a fire that has now actually been proved efficient at 2,000 yards.

"Vibration" and the lighter machine's quickened "period of oscillation" is the shibboleth that spells the superiority of the dirigible's fire. On a swaying aeroplane this has been compared with the jerking of an automobile over an ordinary road. A designer of machine guns and one-time champion revolver shot once told the writer that after having been up in both monoplanes and biplanes, only automatic pistols fired from the hand could be used to advantage. This may be exaggerated, but it is the writer's own experience that in the cabin of a Zeppelin no vibration exists. The slow swaying is imperceptible. The aeroplane, especially the fast light type, is essentially all engine room, and as long as its motor is turning there is vibration. Heavier machines, while less jerky in balancing, generally lose much of the advantage of speed. Machine guns have been fired from aeroplanes, but no great results are on record. Small dirigibles, with everything crowded into a car, would vibrate no less. But the results and details of tests made by the very modern war Zeppelin "Z V," on March 12th, at the Doeberitz Military Aerodrome, the first of their kind to become known, are truly remarkable. At a distance of 1,833 yards it scored a large percentage of hits with its machine gun on a target 12 by 33 feet, supported by kites. Even at 2,000 yards hits were recorded.

This was all done with a machine gun of not much greater range than a rifle's. But when Greek meets Greek in the air, when dirigible fights dirigible, larger calibers are inevitable.

It seems impossible that the history of dreadnought development should not repeat itself. In the air as on the water, the final competition will be in the size of gun that may be carried and the speed that can be made at the same time. A 30-knot dreadnought, with enormous "spotting" masts, if carrying only two extraordinarily high-powered rifles, would hardly need much armoring; it would fight at will at a range where it cannot be hit. The same principle underlies aerial fighting; all the more so because the problem, with the great vulnerability of dirigibles and the impossibility of armoring them, reduces itself plainly to hitting at a greater range, preserved by superior speed, both procured by enlarged size.

A specific complication arises from the danger of igniting the gas by the blast from larger pieces. But if care is taken to fire them only while moving at top speed, the rush of air past the muzzles positively prevents ignition by blowing away the gas. Bracing the gun-mounts against recoil offers no insurmountable difficulty, and there is no danger to the equilibrium.

No less reliable an authority than Dr. Eckener is responsible for equally startling recent revelations about the other kind of aerial marksmanship, dropping bombs to the ground, as practised by modern Zeppelins. From a safe altitude of 5,000 feet heavy bombs were dropped within circles marked by buoys on the water of the lower Elbe, of only 15 feet in diameter, showing that they could be dropped as well into the funnels of warships. Tests made on land showed that from an equal elevation a railroad station could be completely wrecked by four of these bombs. Theory has long indicated the feasibility of these performances, if necessary conditions—heavy weight of bomb, steadiness of aircraft, exact knowledge of the vertical direction, of the distance from the ground, and of the speed over the ground—are complied with. A Zeppelin furnishes all facilities for fulfilling these conditions.

The armament of a war Zeppelin actually includes one piece of heavier artillery in addition to the machine gun. The caliber seems to be little above two inches, to judge from the ranges reported, according to late reports. The target was a box 30 by 15 feet, suspended 1,000 feet above the ground from one of the military captive "kite" balloons. Near the center of both its longest surfaces there were "bull's eyes," black marks corresponding in size with the motor and the pilot of an aeroplane. From an elevation of 1,900 to 2,100 feet the "ZV," at the second trial of 15 rounds from its heavier cannon, hit both of these marks at a range of 2,100 yards, although the target was blown about like a leaf in the strong wind. While firing, the airship circled about the target. At the first trial, also with a total of 15 rounds, both the machine gun and the cannon were very efficient at a distance of 1,600 yards. In the third trial the range was increased to 2,600 yards, again only the cannon being used. The guns are both carried on a platform on top of the hull, and are removed from the proximity of escaping gas.

On March 30th the "Z V" gave a demonstration over Berlin, which puts a sinister meaning to Dr. Eckener's statements. She directly followed the "Hansa," which had traversed the city with the usual hum of the motors, but in silence. The motors of the Zeppelin of to-day are muffled as efficiently as those of the best automobiles, and it has been found that the propellers alone, at any height, escape detection. In very cloudy weather or at night the presence of a deadly airship within easy striking distance may never be suspected. No wonder that Dr. Eckener stated in the same lecture that the perfectly feasible regular airship service to British ports, to catch the "Lusitania" and considerably shorten the trip from Germany to the United States, in the absence of an adequate English air navy, was as yet out of the question for reasons of international politics.

After the new Zeppelin "Z VIII," on March 29th, ascended to 10,000 feet, even the upper air can hardly be considered a safe refuge for the aeroplane.

A protecting airship, cruising above a limited zone, needs only a minimum amount of fuel (easily renewed), and, thus lightened, climbs readily. Correct observations, difficult at best from a high altitude, are hardly helped by the excitement of being attacked, even if the aeroplane escapes destruction.

Wit and Humor Cannot Be Appreciated Without Muscular Movements

By Dr. Leonard Keene Hirshberg, A.B., M.A., M.D. (Johns Hopkins)

WALTER SHANDY, the world's greatest reasoner—he confesses it himself—was master of one of the finest chains of sublimate humor, yet for the life of him he was unable to get one line of it into the head of his wife. Mr. Strickland Gillilan says it's the simplest thing in the world to write a joke. All you have to do is sit down, strike the keys of your typewriter, and there you are. Only you must think of one first. That's where the difficulty arises.

What the subdivisions of humor may be, whether wit, fun, laughter, humor and word-play, are one and the same thing, or all different, is after all not material to an analysis of the question. To arrive truly at the fundamental element of the emotion which arises from the fifty-seven varieties of fun, known under the broad terms jest, wit, jokes, humor, fun and laughter, I selected three recent numbers of *Life*, *Puck*, and *Judge*, and submitted these to twenty individuals of average intelligence to say whether the various pictures, anecdotes, and jokes were or were not funny, and why.

One of the pictures that excited the risibilities of the subjects, was that of a little fellow who had eaten green apples. He was pictured all bent-up with his hands pressed into his little tummy. To a sympathetic mother, he said: "Mamma, I feel like a thunder-storm is inside me." Two who examined this, said: "Poor little fellow, no wonder he feels like a thunder-storm." The others all considered the incongruous rumbling of the stomach as recalling the rolling to be the crux of their interest.

The picture of a young girl sitting on a bench around whose waist were the arms of two young men, was among those shown. The legend, "A Divided Skirt," was printed beneath. One saw the humor in this with "moving eyes," as a "play upon the word *skirt*, vulgarly known as a girl, the tender element of attraction between the sexes, and the composite pleasure of discerning the hidden meaning of the word as well as the present funny vogue of that kind of wearing apparel."

While none of them overtly laughed or smiled, all admitted that the enjoyment or other emotions were accompanied with inclinations to move their facial muscles, or an imaginary movement of those muscles.

An elaborate drawing-room, with husband bending forward intently to his wife, explained this dialogue: "Wifey, will you shed any tears when I die?" The wife, a retired emotional actress, replied: "It is so long since I shed a bushel or two of them, and I am so out of practice, I cannot say," was so far from humorous to the ten women that they even wrote objections to it as "degrading matrimony in the public eyes." The men all considered it funny, although three of them are unmarried, because the husband was "absurd," "silly," "gullible," "sentimental" and "henpecked."

Another illustration of five little, black pickaninnies looking out of a window under which was the sign "Angels Rest Nursery," struck all the observers as "cute," "sweet," "pretty," "pleasant," "amusing," and the like. They said they were inclined to smile, that is, to inhibit or reprove a tender muscular movement of the face. In a word, this picture of *Judge* was considered as in a tender key of pathos, rather than incongruity, awkwardness, or funny, false position.

A disheveled gentleman, with his cravat and collar awry, picking himself up from the nethermost step of a long flight, was shown, with this line beneath the two words, "An Optimist": "Oh, well, I was coming down, anyway."

All of the subjects maintained that this was uproariously funny, because (1) "to obscure his embarrassment, the man offered an unbelievable excuse," (2) "because he was awkward, yet unmindful of his degraded, incongruous position," (3) "there was no one around to accept a flimsy reason for his serious, yet clumsy predicament," (4) "his mechanical and unconscious position of awkwardness and impossible explanation," (5) "absurd attempt to divert attention from his inefficient *faux pas*," (6) "undignified and unexpected reversal of form," (7) "interruption of smooth and even tenor of one's way by an abrupt but not unhappy catastrophe." And so on. In a word, surprise, abrupt termination of smooth sailing thought, embarrassment, lame excuse, double meaning, incongruity, debasement of a neutral or unfriendly person, awkwardness, and mock reasoning were all offered as evidence of the muscular facial contortions that presented this picture as uproariously funny.

Thus it is seen that at the bottom, the stimulus that gives rise to the emotions grouped under the names of humor and pity really causes muscular movements first. These produce the mental states known as pathos, wit, and cuteness. Proof of this discovery is found in the fact that persons whose facial muscles are absolutely paralyzed cannot see a joke. Stolid-faced Englishmen, as well as persons whose cheeks and mouth-muscles are seriously burned or scarred-up, fail to see the points of definite and open jests. On the other hand, the rough, muscular, active movements of slap-stick comedy acts on the vaudeville stage are even funny to paralytics and idiots. For, the observer really laughs at such gyrations by way of his neck, head, belly, and arm muscles. In a word, the coarser the fun, the larger are the muscles that laugh. Even the man in the iron mask can enjoy a practical joke that will make a horse laugh.

The Flight of the House Fly

AT a meeting of the Cambridge Philosophical Society, Dr. E. Hindle described some experiments which he made with G. Merriman in order to determine the housefly's range of flight. During the course of the experiments about 25,000 flies were released under various conditions of weather and temperature. No less than fifty observing stations were arranged where the flies were caught in traps or on flypaper. In order to identify them they had been dusted with red or yellow chalk powder. The experiments showed that the flies winged their way either directly against the wind or obliquely to it. This phenomenon has also been observed in the case of other insects as well as of birds. The greatest distance covered by a fly was 700 meters, and a large part of this lay over open ground. In densely crowded cities, Dr. Hindle does not believe that the fly travels more than 400 meters. In order to secure the widest distribution, fine weather and warmth are necessary. Flies which were released in the afternoon, were not so widely distributed as flies which were released in the morning.

The Structure of Crystals

IN a paper before the Royal Society of London W. L. Bragg investigates the structure of some crystalline bodies, as indicated by the manner in which they diffract X-rays. For a certain number of simple crystals it is found that the interference figures may be attributed to the diffraction of a "white" radiation by a series of points situated on a configuration in space. Each of these points is a simple atom; if an atom, in a molecule, is at least twice as heavy as any one of the others, it is the configuration formed by these atoms which reveals the figure of diffraction. Two atoms of approximately the same atomic weight are nearly equal as centers of diffraction. The lightest atoms of the molecule are not grouped in the immediate neighborhood of the heavy atoms, but occupy intermediate positions. Thus, in chloride of sodium, the sodium atom has six neighboring atoms of chlorine equally near with which it can combine to form a molecule of NaCl. In some cases the atoms are arranged in a simple cube in such a way that layers parallel to the axes of the cube contain alternate atoms of each species.

Correspondence

[The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]

Wireless Distress Signals

To the Editor of the SCIENTIFIC AMERICAN:

Newspaper reports of the false "S O S" supposed to have been sent by the "Siberia," unfortunately place this single exceptional instance in a light which, in the public mind, may offset a thousand correctly transmitted signal messages. Inasmuch as the signals S O S

s o s
· · · — — — · · · are quite dissimilar from

m b s
M B S — — — · · · · · · it seems evident that

the confusion is due to the gross carelessness of the operator rather than the apparatus employed. If the signals had been H O S or I O S the excuse might have appeared more plausible, for the resemblance would have been closer.

In a pending patent the writer has proposed to prevent such serious confusion by assigning a definite tone combination which is to be used only for distress signaling, a signal which cannot be mistaken for static or other ship calls—even by a novice. The plan has been satisfactorily tested. If such a tone combination can be universally agreed upon and adopted for exclusive use in distress signaling confusion will be obviated. An ordinary seaman can tell the difference between such a distress signal and all other, where a partially trained operator may fail to pick out the present distress signal with certainty. According to this plan the distress signal will be analogous to the Klaxon horn, and its use should leave no doubt at the receiving station.

Even if this plan is not subsequently adopted the writer would suggest that the present distress signal can be made more efficient by

1. Requiring that it be sent by a musical pitch transmitter, or its equivalent, so that it can be distinguished from static X's. This means that open spark sets must be remodeled or replaced by more modern equipment.

2. Instructing all operators to give the dashes of the O full value, or more than full value (—— —— ——; not — — —), to distinguish from the dots of the two S's. A FULL space interval should also be allowed between each signal group so that the apparent running over of signals is prevented.

As matters stand, there ought to be an investigation to ascertain why the "Siberia" did not hear the false relayed radio reports and stop them. Although radio communication is far from perfect, and it should be remembered that the ordinary telegraph and telephone are imperfect, it has certainly advanced to a point where it is practical and normally reliable.

Minneapolis, Minn. PHILIP E. EDELMAN.

The Rhinoceros Beetle

To the Editor of the SCIENTIFIC AMERICAN:

Since the publication of my article concerning Dr. Frederichs' discovery of a wonderful fungus which destroys the larvæ of the well known Rhinoceros beetle, I learn from some correspondence I have had with Manila that Dr. Frederichs has himself found this identical fungus at work in the Philippines.

I quote from an official paper just received from O. W. Barrett, Esq., Chief of Division of Horticulture, Manila: "Dr. Frederichs of Apia has spent about one month here investigating cocoanut pests, and finds the same fungus (*Metarrhizium* (*Chromostylium*) *anisopliæ* (*Metsch*) *Sorokin*) is in evidence here. In fact, it is probable that this fungus has been instrumental in keeping the 'Uang' in check for many years past in the Philippines." H. J. MOORS.

Apia, Samoa.

Modern Naval Ordnance

To the Editor of the SCIENTIFIC AMERICAN:

In No. 6, vol. cx, February 7th, you mention the French 13.4-inch gun: shell, 1,433 pounds; velocity, 2,657 feet. The energy by $\frac{mv^2}{2}$ works out equal 70,000 foot-tons, approximate. So this shell is, as you say, somewhat more powerful than our own 14-inch shell. If we take into consideration the very important factor of "ballistic coefficient," it would seem to me that the French gun shows a very considerably higher efficiency, as that factor is approximately as 8 to 7 in comparison with our 14-inch piece. This is shown by formula for ballistic coefficient: $\frac{w}{d^2}$; viz., weight of the shell divided by square of caliber of gun. The German 15-inch gun, which you mentioned some time ago, with its shell of 1,667 pounds, would also look inferior to the French piece in that respect. What the weight of the British 15-inch gun's projectile is I know not; if it be 1,800 pounds, it would be just about even with the French piece.

Would you kindly discuss these matters in your esteemed publication? REV. J. H. MEYER, S. J.

New Orleans, La.

"Gore-shaped" Harbor Entrance

To the Editor of the SCIENTIFIC AMERICAN:

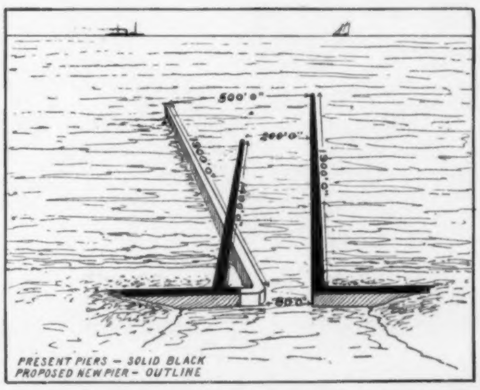
I am sending you a sketch of what I think is the proper way to construct an entrance to a harbor such as the ones named. I have sent copies to the Minister of Public Works, Ottawa, and to the Honorable the Secretary of the Interior, Washington. There are many harbors on your side of the lakes that are entered between piers, and I am sure a like experience must be had.

I should very much like to see a harbor entrance constructed as indicated, before I pass in my checks, as I am sure that it will work as claimed.

Owen Sound, Ontario, Canada. E. DUNN.

The letter referred to by our correspondent follows: "*Sir:* I beg to submit to you a plan of what I think is the proper way to construct a harbor, or rather, the entrance to one, on an open beach, like Goderich or Port Stanley. Both of these harbors are entered between piers. Those of Port Stanley are about 1,000 feet long and 85 feet between them. Those of Goderich are, the south one 1,500 feet and the north one 1,900 feet long and 200 feet between them.

"Where They Fail.—Those of Port Stanley cannot be taken in a gale off the lake. When I was in the Government steamer "Petrel" I many times ran back to Long Point, 60 miles, rather than take the risk, and she was but a small vessel. In this case, however, the piers being so close together there is no sea at the harbor end; but in the case of Goderich, where the



Proposed reconstruction of south pier at entrance to Goderich harbor.

piers are 200 feet apart, a heavy sea runs right into the harbor. They have built at the harbor end what they call a check water, which does not always check. I have lain there when the sea has broken over it in a solid mass, when loading or unloading of vessels was impossible. My ideas are the result of my observations of the working of the sea in natural harbors. If you will take a chart of the Georgian Bay, and compare Owen Sound Bay with that of Colpeys, which has three islands off its mouth, you would naturally think there would be less sea at its head, under the same circumstances, than at the head of Owen Sound Bay, but such is not the case. The gore shape of the bay is the cause, it being 7 miles wide at its mouth and tapering to half a mile at the head. Colpey's Bay, on the other hand, is nearly parallel, and whatever sea passes through the gap between White Cloud and Hay Islands, rolls right to the head.

"I have many times run before a storm into Owen Sound, and from the entrance to the head the sea would be quite noticeably less every mile, and at the head not half as high as the head of Colpey's Bay. Gore Bay, on the north side of the Manitoulin Island, gives the same evidence, that is, the shape of the bay kills the sea. I made a miniature harbor and entrance on the same scale as the sketch herewith, and found it worked as I expected."

The Problem of Our Navy

To the Editor of the SCIENTIFIC AMERICAN:

As an old subscriber to the SCIENTIFIC AMERICAN, I have been very greatly interested in the series of articles now being published on the "Problem of Our Navy," and especially in what you say in article IX about educating the public to view this matter in an intelligent manner.

My purpose in writing you this is to call your attention to something which, in my opinion, is doing a great deal to damage the Navy in the interior States. I am a farmer by occupation, and as such I keep several farm papers of the better class, and these are, as a rule, not hostile to Government expenditures on naval and military matters, but there are a great number of cheap farm papers being printed in this country which have a circulation of from 500,000 to 750,000 subscriptions, and about every other issue has in it some article headed "150 Million Dollars for Navy," or "Every Time Navy Fires a Shot the Value of Your Wheat Field or Flock of Chickens Goes Up in Smoke." Now, in my opinion, this is doing a great deal to injure the Navy, as most of these farmers, who comprise a large part of the voters, are living in the interior of the country. Furthermore, I know a great many of these men who read no other papers at all except some country paper which has equally warped opinions. I have just read an article in a large city newspaper headed, "Naval Efficiency," which went on to tell how prompt the Navy was in the Mexican crisis, and how it could have, to use one of their own phrases, "plowed the seas in search of any enemy in twenty-four hours," as though there was no difference between a first-class naval engagement and bombarding a more or less defenseless harbor. KARL F. JUGLER.

Black Pine, Oneida Co., Idaho.

436,682 Tons of Valueless Water Shipped With Corn Each Year

In several particulars the systems used by United States shippers are far less economical than those employed by foreign shippers, notably in Germany. Food is started on long freight journeys in such condition that heavy freight charges must be paid on elements which have to be taken out of the food at the end of the trip before it can be used as food. One of the heaviest wasted freight items is the freight paid for the transportation of excessive moisture in corn, and in potatoes to be used for stock food or in the manufacture of starch. In Germany the culls and faulty potatoes, which in this country are thrown away, are dried so as to remove all excess water and then shipped to various points for stock feed purposes. This practice of drying potatoes for stock feed and uses in the arts has not gained great headway in this country. As a result the culls commonly are thrown away and starch is made from potatoes only when there are excess crops which make them available at a cheap price which permits of shipment to the factories. Potatoes in their natural state contain upward of 70 per cent of water which has no special nutritive value. Long shipments of potatoes, therefore, in their natural state are not practicable, whereas the Germans who have dried out the excessive water find it practicable to ship the dried product.

The waste water now being shipped in corn in the United States has a serious bearing on the actual cost of corn, and also is one explanation for the great shortage of cars at the corn shipping seasons. The American people are paying freight on 436,682 tons of water in shipping their corn from the producing sections to the market. This means that at a time when there is a great shortage of cars, there is the equivalent of over [illegible] freight cars of 60,000 pounds capacity loaded with water which is responsible for the enormous losses resulting from the deterioration of shelled corn before it is finally consumed. Figuring a car length at forty feet, this means that each year a train 582,240 feet long, or over 110 miles, not counting the locomotives, is engaged in nothing more profitable than hauling water from a few miles up to a thousand miles in the case of corn shipped to the seaboard points from the central corn producing area. Exactly how much excess freight this represents cannot be accurately determined, but as the freight rate on corn is about one cent per ton-mile, it can be seen that this hauling of useless water in corn adds materially to the cost of the product before it reaches the consumer.

Many of the big elevators in the central corn markets now have machinery for drying out excessive moisture. Comparatively few of the smaller collecting elevators have these drying machines, and the only method of drying corn possessed by most producers is storing it properly in cribs. Corn shipped during the summer months, therefore, has had a chance to dry out in the crib, but in the cold and wet months crib drying is not very effective and corn shipped during these months generally has a moisture content above No. 2 grade. Because of the moisture in such corn, few country buyers will buy corn from farmers except as No. 3 or No. 4 grade. If it grades better, the buyer, and not the producer, gets the benefit of the better rating. Under the present system the farmer has no way of determining the actual grade of his corn in his crib, and having brought it to a shipping point could not afford to return it to his bins. There is, however, a movement in communities where co-operative production is being established to inaugurate a system whereby farmers can have their corn graded at the crib and thus determine whether or not they will sell it, before they have hauled it to a shipping point. The question of moisture content and the tremendous waste in freight paid on water that is later dried out of the corn has not heretofore, according to the specialists, received the attention it deserves.

Interesting Features of Cup-defender Construction

Details of Resolute, Vanitie and Defiance

COMPLEMENTING our article and drawings of May 2nd, giving the principal features of the three cup-defending yachts, we present in this issue excellent illustrations of the "Resolute" on her first trial spin, and also some interesting details of the hull and spar construction of the yachts.

It will be noticed that each boat is framed on the system which was first originated, for yacht construction, by Herreshoff in the "Constitution" of the year 1901. As far as we know, previous to that date, reliance upon keeping the hull to shape was placed upon a large number of closely spaced, light, and shallow frames. Now the strength of any member to resist bending in the plane of its depth, others things being equal, is generally proportional to the square of its depth. It was in recognition of this law that Herreshoff, in building the "Constitution," determined to introduce a number of deep, web frames, thereby greatly increasing the stiffness of his hull without making any corresponding increase in the weight of the material used.

When "Constitution" made her appearance it was mistakenly reported that Herreshoff had abandoned transverse framing in favor of a system of longitudinal framing. As a matter of fact, he had increased the stiffness of the transverse framing, and the so-called longitudinal framing consisted of T-irons and bulb angles, introduced, respectively, along the seams of the plating and intermediately between the seams, in order to form the butt joints and to assist in holding the very light hull plating to true form. It is a distinct tribute to the constructive skill of Herreshoff that his two competitors in this season's racing have adopted the principle of construction which distinguished the "Constitution" of twelve years ago.

"RESOLUTE."—There are sixty-two frame stations in the hull of the "Resolute," and on seventeen of these there are web frames, varying in depth from 8 to 12 inches. These frames run entirely around the hull and across the deck. Intermediate between each pair of web frames are three smaller sub-frames, which are carried up well into the bilges, but not above the water line. The six strakes of plating are laid on with flush seams, the edges of the plating being riveted to nickel-steel, 4½- by 4½-inch T-irons, running along the seams, with 3-inch by 2-inch bulb angles running longitudinally midway between the seams. The covering board of the deck is of galvanized steel 7/32 of an inch thick by 18 inches wide. The balance of the deck is covered with aluminium plate 7/32 of an inch thick and 18 inches wide, the deck plates being lapped toward the covering boards. The whole deck is covered with canvas and sanded. The manganese hull plating is 5/32 of an inch in thickness, except the top strake and the garboard strake, which are 7/32 of an inch in thickness. There are six strakes of hull plating, the bottom strake overlapping the lead, to which it is very securely fastened.

Evidently, Herreshoff expects to do some experimenting with his sail plan, for he has provided two mast steps, one 33 inches abaft of the other. Judging from the photograph of the trial spin of "Resolute," it would look as though the footing of the mast was at present on the after step.

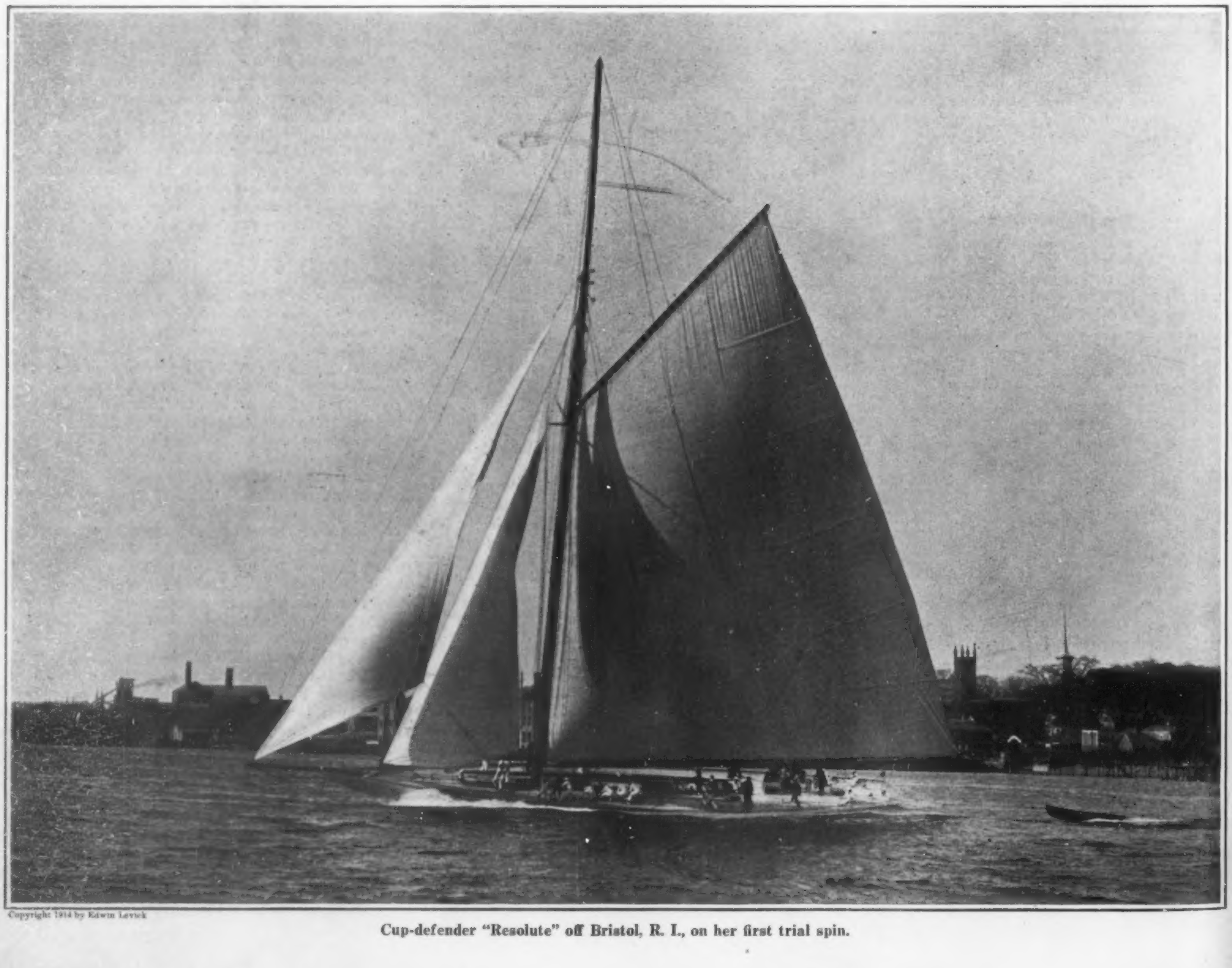
The mast, 20 inches in diameter at the foot, is built of nickel steel, stiffened longitudinally with ten 1 by 1½-inch nickel bulb angles. The foot of the topmast houses within the mainmast, footing upon a hollow steel cone riveted to the shell of the mast, as shown in our drawing. About every 10 feet of the length of the mast there is a steel diaphragm, cut away at its outer periphery to allow the bulb angles to pass through, and lightened by having holes drilled out.

"VANITIE."—An interesting drawing among those showing the construction of "Vanitie" is that of the junction of the framing with the lead. A bronze casting, to the flanges of which the frames are riveted, is attached to the lead by heavy lag-screws—an oak plank being interposed between lead and casting. Two other interesting details are those of the gammon-iron and rudder-post, each of which in a bronze casting. The gammon-iron makes a very neat finish at the stem head; it will be noted that it is recessed to receive the top strake of the plating. The rudder-post sleeve casting is also a neat piece of design. The Gardner boat has the largest centerboard of the three yachts; also, the center of gravity of the lead is lower than that of the other boats, and this, coupled with the harder bilges, would tend to give the "Vanitie" greater sail-carrying power than her competitors. The "Vanitie" has an extremely fine bow, with a very decided hollow—a feature which has marked the latest of Gardner's fast yachts. This designer has always built a very beautiful boat, and "Vanitie" will probably be the most shapely of them all.

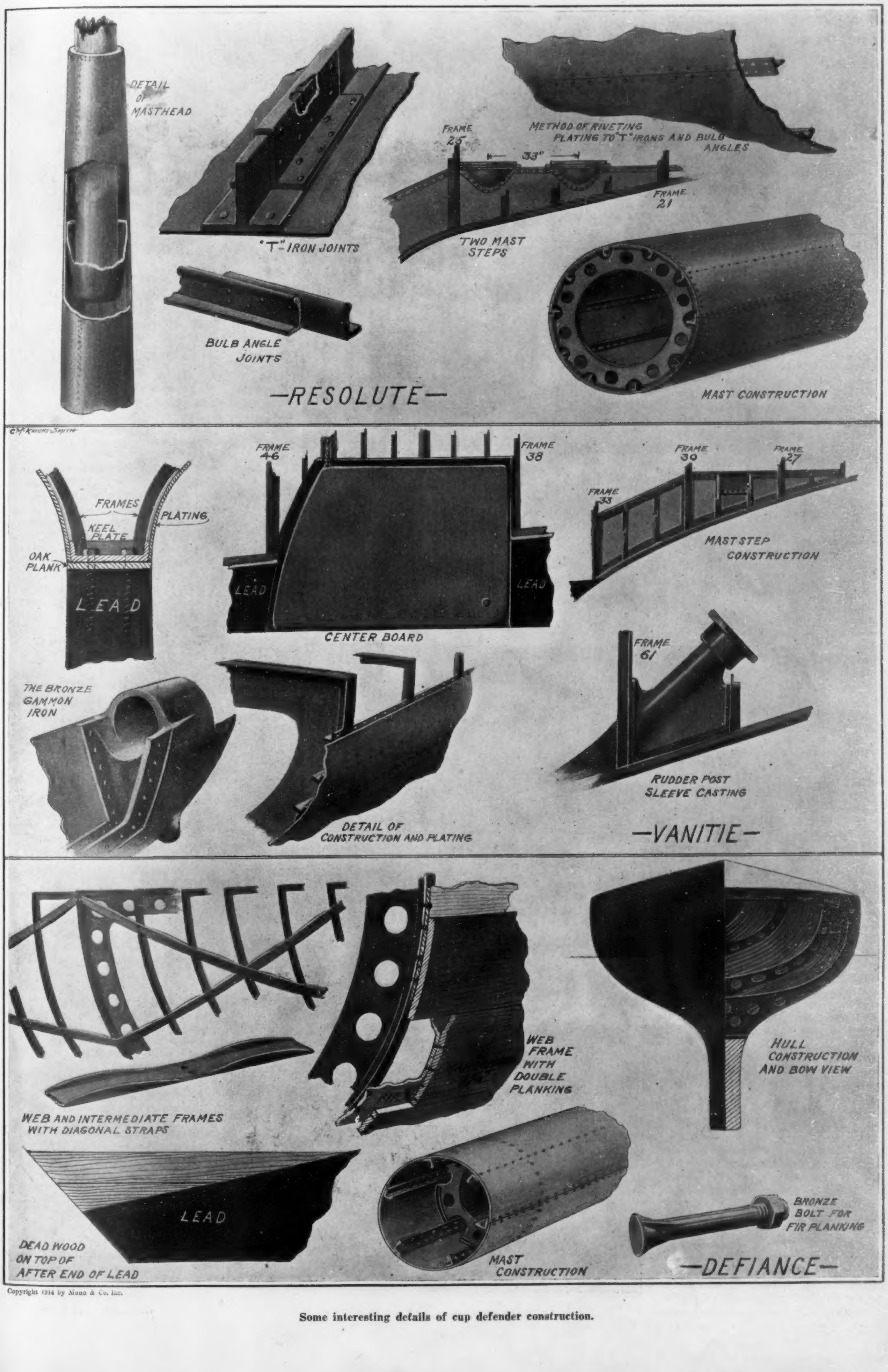
"DEFIANCE."—The half midship section of "Defiance" shows very clearly the nature of the webbed frame construction, to which reference has been made above. Owen, her designer, more than either of the others, has cut away every ounce of superfluous material, not only in the web framing, but in every part of the construction from which it could be removed without impairing the structural strength.

The loss of longitudinal bending strength, due to the adoption of a wooden skin in the place of bronze plating, is compensated in the Owen boat by making the seams of the inner and outer skins of wooden sheathing break joints, as shown in one of our drawings. We noted in our previous article that the inner skin of fir is fastened to the framing by bronze bolts, one of which is shown herewith in a separate sketch. Attention also is drawn to the bronze screws which pass through the inner skin from the inside and take hold of the 1¼-inch outside mahogany skin. The hull will be painted with white enamel paint below the waterline and above the waterline the mahogany will be highly varnished. An interesting detail is the turning up between the transverse frames of the edges of the diagonal strapping of the hull, in order to gain additional stiffness.

The mast construction is generally similar to that of the "Resolute," with the difference that there are six bulb angles of deeper section running the length of the mast in place of the ten shallower bulbs used in the mast of the "Resolute."



Cup-defender "Resolute" off Bristol, R. I., on her first trial spin.



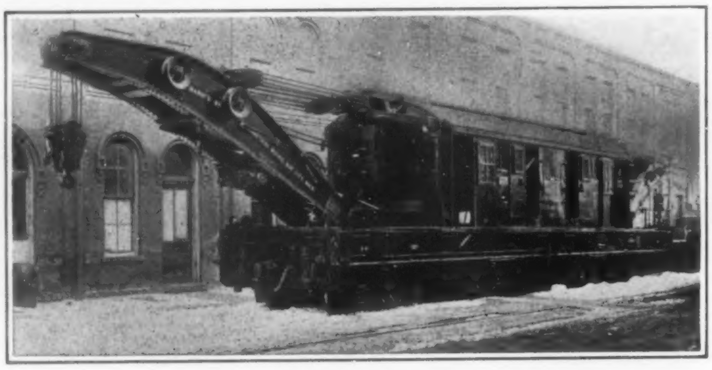
Some interesting details of cup defender construction.

Powerful, electric wrecking crane designed for the underground clearances and conditions of the Grand Central Terminal.

A 100-ton Tunnel Crane

A DOUBLE-END electric wrecking crane with independent hundred-ton capacity cranes at each end, has been received, recently, by the New York Central Railroad for use in case of accidents or wrecks within the electric division of the road. The crane is especially designed for the underground clearances and conditions existing in the Grand Central Terminal, although it may be used also on the main line of the electric division. The machine will be dispatched at high speed under its own power to the scene of the accident.

To design a crane of the large capacity required, under the unusual limitations imposed by the conditions of tunnel operation, was not a simple matter. At the express level head-room for raising the boom and room at the side for slewing were both restricted. Also excessive concentration of wheel loads had to be avoided. The crane had to be designed to perform wrecking operations that are quite different from those found elsewhere.



One of the cranes with lifting capacity of 160 tons.

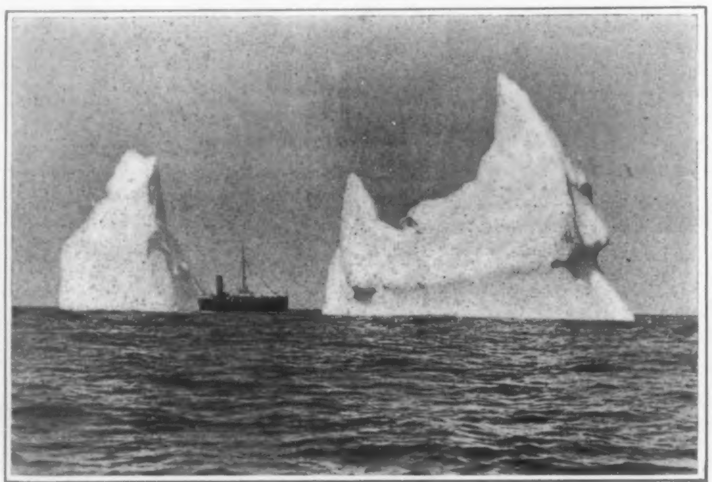
The procedure in case of a wreck underground will be somewhat as follows: If possible, the wreckage would be lifted clear of the track, and the crane would then back out with it. If, on account of lack of head-room or because of the size of the piece, it could not be raised off the track, one end would be lifted with the main hoist, and with the auxiliary hoist a special truck would be placed under it. The crane would then drag away the load.

The car body of the crane is 67 feet long with a wheel base of 51 feet, and it is carried on two compound trucks made up of two four-wheel trucks each. A cradle on which the car body rests allows the compound trucks as well as each single truck to have perfect freedom to swing when making turns. There is a comprehensive system of air-operated telescopic outriggers or jack-beams to aid stability during heavy lifting, and to distribute the load over a greater area. The independent cranes at each end of the car have a structural mast and boom, accurately turned roller path and rollers, and slewing mechanism. All of the motions of operation may be performed independently, and with loads up to the capacities of the motors may be performed simultaneously. All the clutches are operated pneumatically to insure quick and sure engagement and release. Four 200 horse-power motors are used for propelling the machine, and two of 150 horse-power each for hoisting and for operating machinery. The propelling motors are controlled from each end of the car, and all four may be used for traveling, or, if desired, only the two at either end. They are capable of operating safely on fluctuations of line voltage between 300 and 750 volts, direct current. For intermittent and emergency service, as might be required with the third rail out of commission, or when suitable cable connections could not be made with the feed line, there is installed on the crane a high-capacity storage battery, consisting of 230 cells. It has a capacity of 75 amperes for 8 hours with a maximum discharge rate of 350 amperes for 2 hours.

On a formal test, conducted by the railroad officials, the crane propelled itself at the rate of 34 miles per hour while hauling an 80-ton rolling load. On solid foundation with outriggers, the cranes showed a capacity of 100 tons with a 24-foot 2-inch radius straight ahead, or 6 feet 6 inches to either side of the center. The same capacity was shown with a 22-foot radius operating at 12 feet either side of the center, and with a 13-foot 8-inch radius swinging 180 degrees. Without outriggers the capacity was 50 tons and 25 tons with a 13-foot 8-inch radius swinging 180 degrees. The crane was designed and built by the Industrial Works from specifications prepared by the New York Central Railroad.

The Iceberg Patrol

EVER since the "Titanic" disaster travelers have looked with new respect upon those ancient ice monsters that come down out of the North each year, on their final voyage to the torrid South. Instead of eagerly hoping that an iceberg will be sighted, their presence is looked upon with apprehension. During the iceberg season the North Atlantic is patrolled by United States revenue cutters in the endeavor to locate icebergs. The accompanying photograph shows two huge icebergs and the United States revenue cutter "Seneca," which has just discovered them. The find was made on Easter Sunday. The icebergs were moving southward rapidly into the path of ocean steamers. A warning was immediately sent out by wireless telegraphy to all ocean steamers in the vicinity. The larger one of the icebergs rises to a height of over 125 feet above the water, making the "Seneca" appear like a mere pygmy in comparison. The Government is using every precaution to avert another "Titanic" disaster.



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U. S. revenue cutter "Seneca" and two giant icebergs she has discovered.

Fire Protection on Ocean Liners

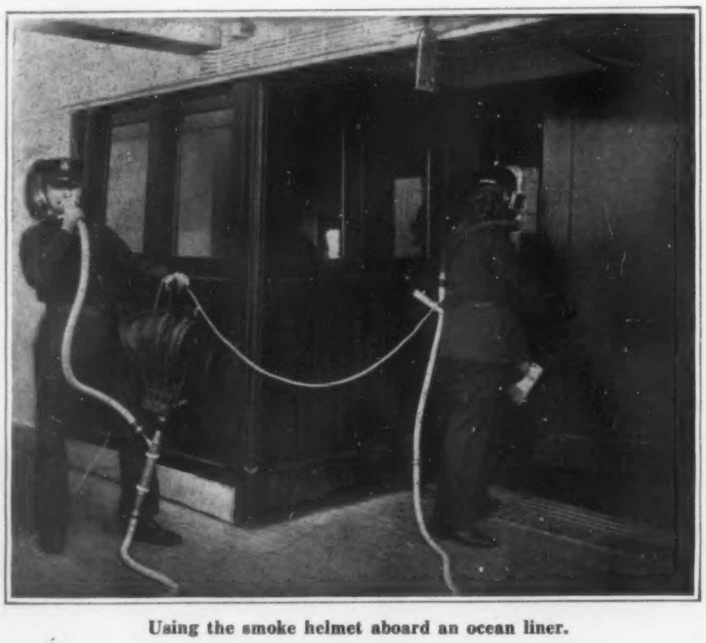
By Dr. Alfred Gradenwitz

THE increasing development of ocean navigation has resulted in attempts, on the part of engineers, not only to improve the technical appointments of steamships and to augment the comfort of passengers, but to provide as efficient a protection as possible against any risk of accident. At the recent London Conference, representatives of all the leading nations agreed upon the most appropriate measures to be taken in this connection. On account, however, of the unprecedented dimensions of the "Imperator" and "Vaterland," the latest additions to their fleet of ocean liners, the Hamburg-American Line, in the case of these mammoth vessels, decided to go far beyond the rules laid down at this Conference, adopting not only an improved and admirably comprehensive system of water-tight bulkheads, but a novel type of fire-protection apparatus.

It will be readily understood that a floating palace, accommodating a population of over 5,000, should require far more efficacious measures of precaution than the average liner of relatively modest dimensions, the more so, as any accident there may assume the proportions of a real catastrophe. This is why the two vessels in question have been equipped not only in accordance with the best practice in connection with the fireproofing of buildings, but with many new and unique arrangements.

All iron walls of the passenger decks have been lined on both sides with a fire-proof cement coating, cast on wire gauze or molded in slabs. Comprehensive tests made in a special building at the Central Headquarters of the Kiel Fire Brigade, have brought out the excellent qualities of walls and doors such as these. Any bulkhead openings traversed by the passenger corridors on the various decks have

(Concluded on page 421.)



Using the smoke helmet aboard an ocean liner.

A two-inch gap separated the sweet-pea from the stick.

Have Plants an Unknown Sense?

Some Curious Instances Which Seem to Indicate That the Tendrils and Roots of Plants Have a Mysterious Power of Feeling Objects at a Distance

By S. Leonard Bastin

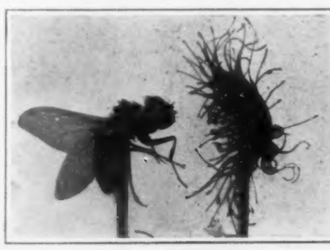
The plant leaned over and secured a hold with its tendril.

IN his pursuit of knowledge the man of science is continually coming across matters which it is difficult, if not impossible, to explain. One of the most sensational facts that have recently come to light is the discovery that plants appear to possess a special sense. It is too early to hint at an explanation of the happenings which force us to this conclusion, but we now know that plants are able to feel objects at a distance. That is to say, they act as if they were aware of the presence of a certain thing, even though they may not be in contact at all. It may be of interest to give a few of the most startling cases which have come under notice.

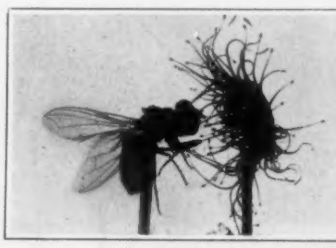
Everybody knows that the sundew catches flies. The leaves of this plant are, of course, covered with tentacles which, being very sensitive, close in round the captive. But the foliage of the sundew has another remarkable characteristic. If a fly is fixed about half an inch from any of the leaves a most astonishing thing happens. After a short interval it is seen that the sundew leaf has moved perceptibly toward its victim. Soon the cruel tentacles have actually reached the unhappy fly and are seen to be slowly moving round their prey. There is now no chance of escape, and with every moment the fate of the insect becomes more certain. A few feeble wriggles and the fly is dead. When one comes to think of it, it is very strange that a plant should be able to go in pursuit of its prey in the manner indicated. Some plants are very unscrupulous; unable to secure a living on their own account, they prey upon the more hard-working of their fellows. Such is the dodder, a most virulent parasite, which, apart from the first few weeks of its existence, has no roots or leaves and exists as a blood sucker on other plants. The seed of the dodder germinates in the soil, and from this arises a curious thread-like growth. Now it is of vital importance that the young dodder should be able to seize hold of some suitable host, such as a clover plant, for instance. It is strange to watch the manner in which this thread-like growth works in and out through the grass stalks, seeking for a victim. When it comes within a certain distance of a clover plant the dodder grows forward at a very rapid pace until a hold is secured. Even the sturdiest plant must go down before the attacks of the cruel parasite. The thread-like shoot is, within a few weeks, multiplied by the thousand, and from every point are produced suckers which draw away the life-giving sap.

In much the same way the tendrils of climbing plants show quite clearly that they can feel things at a distance. A young pea plant which was used in an experiment proved to be astonishingly clever in this respect. A stick was placed near the plant at a distance of two inches, and during the few hours which followed a very strange thing happened. The tendril, which at first was held between the leaflets, where it had been developed, dropped down to a horizontal position. This was, of course, merely a matter of growth, but it was almost at once followed by a very decided movement of the tendril toward the stick. Finally, the whole of the upper shoot of the plant leaned over, meanwhile the tip of the tendril was busy making sure of its hold. One could not very well get away from the idea that the tendril knew, if the word is permissible, that a support was within reach.

Darwin once said that in their clever ways the root tips of plants seemed to evidence as much intelligence as was to be seen in the lower animals. The following instances show that the great scientist was stating the case very mildly.



Fly set up before a sundew leaf.



Reaching the fly with its tentacles.

The fern sent down a root on the outside of the pot down to the water in the saucer.

How the hazel roots went down through the willow.

The trailing cactus sent down its roots through a hole in the roof.

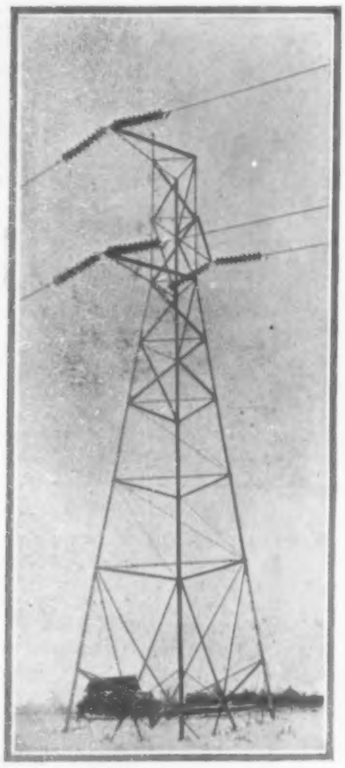
Sometimes plants find themselves in very awkward situations. Such was the fate of a hazel bush, the seed of which had been placed in the upper part of an old willow tree. Now there was a certain amount of soil, formed of decayed leaves, where the seed of the hazel tree started, and for a time this was sufficient for the needs of the bush. But as the plant increased in size the need for more root room became imperative. Yet the hazel tree was a full 12 feet above the ground. Now a strange thing happened, for the hazel bush started to send out roots to the soil beneath. These traveled downward through the hollow trunk of the willow, and finally reached the ground. When this occurred the hazel bush at the top of the tree started to flourish with renewed vigor, and at the moment of writing threatens to become more prosperous than its host. Another strange case of a plant growing down to soil many feet beneath comes from South Africa. This was a species of the trailing cactus which was rambling over the roof of a shed. The roof was formed of galvanized iron, and at one point rust had eaten its way right through. As soon as the stem of the cactus reached this point it at once started to send down an immense quantity of roots through the hole to the ground beneath, a distance of 9 feet. We may take it that the plant was not satisfied with its existing accommodation, and the soil in the shed (which happened to be nice soft mold) offered a tempting medium for fresh root activity. But how on earth could the plant know that it would reach the ground at the end of the journey through the air?

A few years ago some plants of the tropical creeper known as *monstera* were established in a greenhouse. These plants are very fond of rambling about the roofs of the structure in which they are growing, and will often send down roots to the ground. In this particular case the plants made no attempt to develop their aerial roots until they were over a large water tank. Then the roots were produced in abundance, and these traveled down through the atmosphere and finally reached their goal many feet beneath. In another case a little fern sought out some water with an intelligence that seems to be almost uncanny. The plant was growing in a pot, which was kept standing in a saucer; the latter was always well filled with water. Now one may suppose that the fern did not have a sufficient supply of water to meet its needs in the ordinary way, and it determined to get into touch with that in which the pot was standing. Accordingly, the plant sent down a special root, on the *outside* of the pot to the water in the saucer.

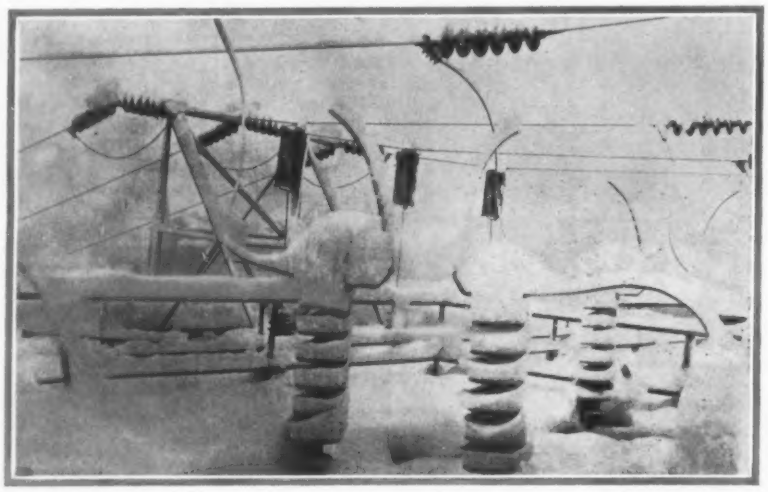
In conclusion it is interesting to call to mind a very striking case of root intelligence which was observed by that celebrated botanist, Dr. Carpenter. The instance has never been explained, and it may perhaps be a good plan to give the original description, which was published in 1860. It is as follows: "In a little hollow on the top of the shell of an old oak (the outer layers of which, however, and the branches are still vegetating) the seed of a wild service tree was accidentally sown. It grew there for some time, supported, as it would appear, in the mold formed by the decay of the trunk on which it had sprouted; but this being insufficient, it has sent down a large bundle of roots to the ground, within the shell of the oak. These roots have now increased so much in size, that as they do not sub-divide until they nearly reach the ground, they look like so many small trunks. In the soil, however, toward which they directed themselves, there was a large stone, about a foot square, and, had their direction remained unchanged they would have grown down upon this. But about half a yard above the ground they divide, part going to one side, and part to the other; and one of them branches into a fork, of which one leg accompanies one bundle, and one the other; so that on reaching the ground, they inclose the stone between them, and penetrate on the two sides of it."

Inventions New and Interesting

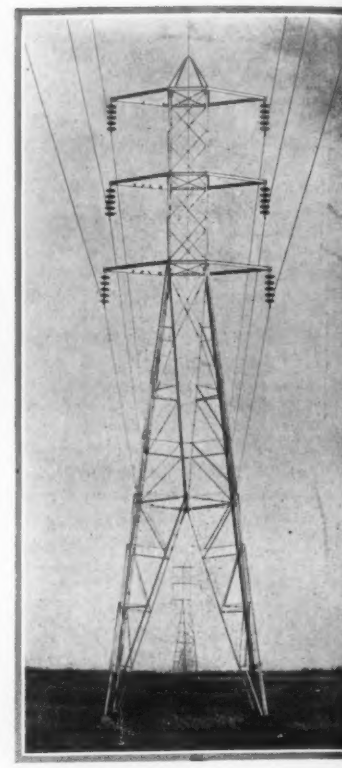
Simple Patent Law; Patent Office News; Notes on Trademarks



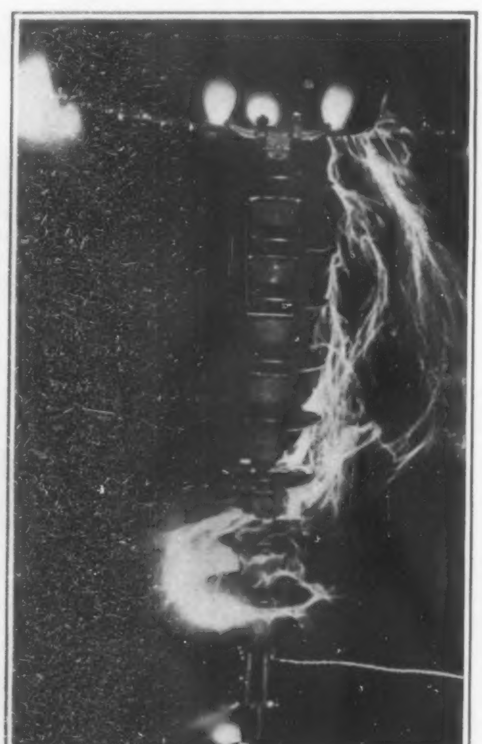
How the "strain" insulators are used.



Insulators buried in snow at the Great Falls power plant, Butte, Montana.



Example of "suspension" insulation.

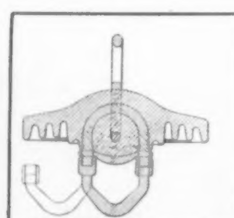


Subjecting a chain of suspension insulators to a break-down test.

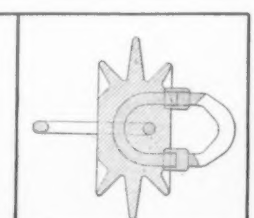
Evolution of the High-tension Insulator

LESS than a quarter of a century ago the first alternating current power transmission line was erected in the United States. The current was transmitted at 3,000 volts, which was considered very high pressure in those days. With that beginning the development of high-tension transmission lines progressed steadily, until by the end of the century, 60,000 volts had been reached. Then, for a time, there was a halt. A serious obstacle was encountered. The development of generating and transforming machinery had outgrown the development of insulation and the former had to wait for the latter to catch up. When a new system of insulation was discovered, high tension took up the march again and there was steady progress, until, now, we have transmission lines of 150,000 volts and consider 250,000 volts not an impossibility, but a probability in the course of the next few years.

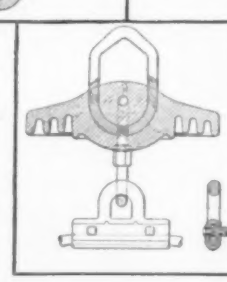
The making of an insulator may seem a very simple thing, involving merely the quantity of insulating material placed between the conductor and the support. That was the first idea, but it was soon found that insulators exposed to the weather accumulated impurities, dust and the like, so that when they became wet,



Section of suspension insulator.



Section of strain insulator.

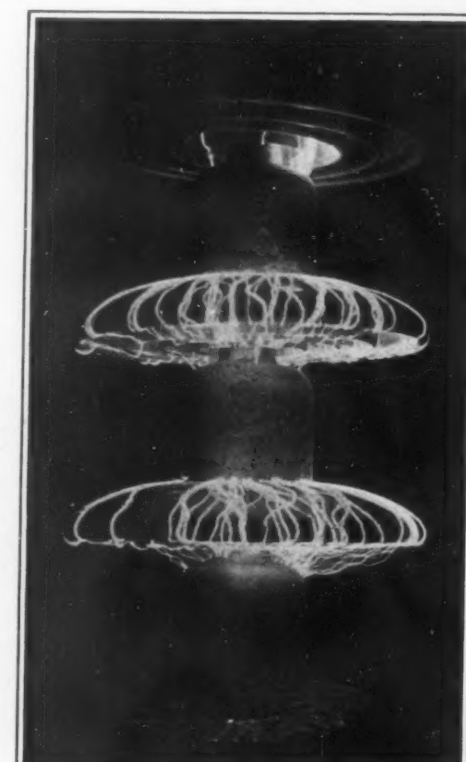


Suspension insulator and line clamp.

they offered a path—more or less imperfect, but nevertheless a path—for leakage of electricity. Then more attention was paid to the shape of the insulator. It was formed with a number of petticoats so as to increase the under surface on which dust and rain would not be liable to collect. With increase of voltage the insulators became larger and larger and the petticoats more numerous until finally they became so cumbersome as to present serious mechanical difficulties in their construction and in the maintenance of the poles upon which they were mounted.

The use of higher voltages also developed other weaknesses. Glass was found too brittle and liable to break with variation of temperature. Furthermore, it was easily wetted, so that in rainy weather a film of water would form upon it. Porcelain was substituted for glass and found better in many particulars, but its chief insulating quality lies in the surface glaze. When this is cracked—and it is liable to be cracked by action of the weather—moisture entering the cracks will expand when frozen and rupture the insulator, resulting in a short circuit. Unfortunately when a high-tension line is short circuited, surging is set up which is liable to rupture other insulators along the line. The effect is cumulative, so that serious damage may result from one defective insulator. A search was made for better insulating material, and a number of compounds have been discovered which show greater mechanical strength, which are unaffected by temperature changes and which, being of an oily nature, are not readily wetted with water; that is, the water collects in drops rather than in a film over their surface.

But the problem was more than one of material only. It was a mechanical problem. The pin type of insulator had been outgrown. The next development was to suspend the insulator from the cross arm, instead of supporting it on a pin. Because a flexible support can be made much lighter than a rigid one, this reduced the weight on the cross arm at once. The conducting wire could be supported at a greater distance from the cross arm than was possible before.

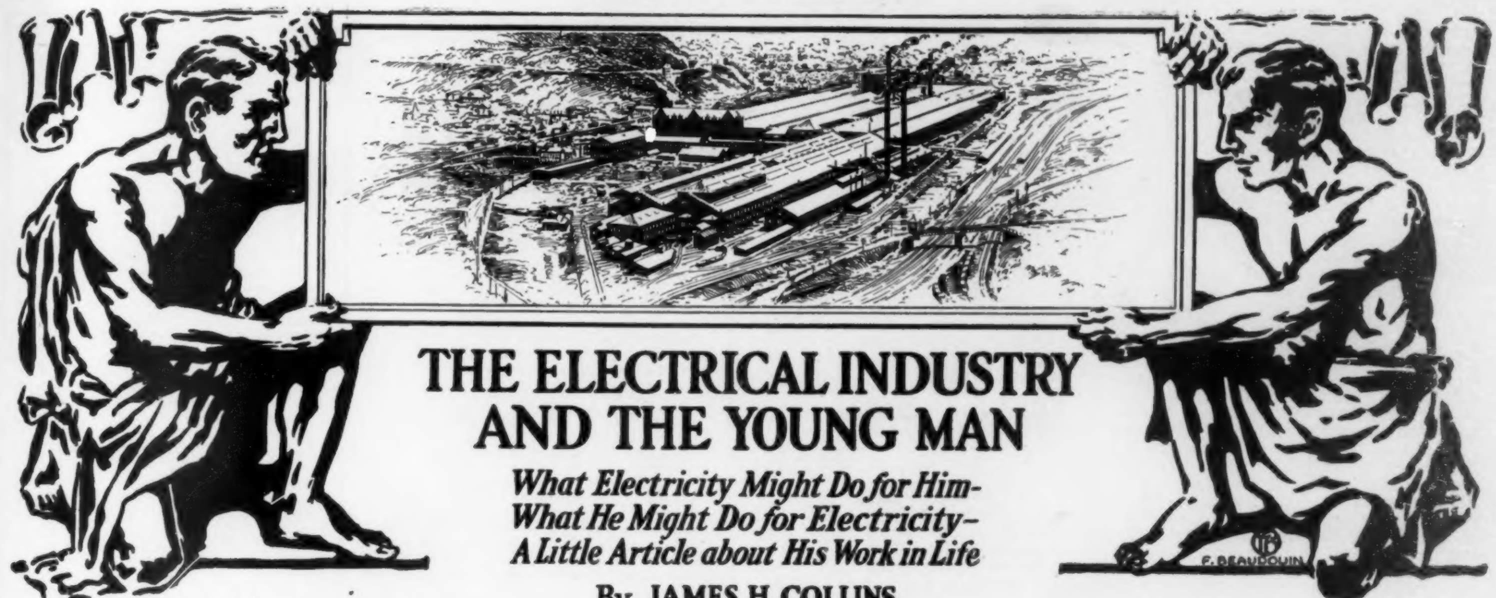


Flow of sparks around the skirts of two insulators; the top disk is punctured.

Furthermore, a chain of insulators could be used in place of a single, large, rigid insulator. This is the type of insulation now in common use on high-tension lines, the only objection being that the line is apt to sway in the wind and might come in contact with its support. This may be prevented by proper spacing and the use of lateral guy lines also made up of chains of insulators known as "strain" insulators. Still another method is to "dead end" the conductor at each pole by means of "strain" insulators, using short loops to carry the current past the cross arm. Both the "suspension" and the "strain" types of insulators consist of disks formed with petticoats or flanges and furnished with hooks at each side, to permit of connecting any number together in a series long enough to provide the desired insulation. The series is often "graded" from a large insulator at the conductor to a small one at the support, thus reducing weight and at the same time increasing the insulating qualities of the series.

The accompanying detail drawings illustrate the degree of perfection to which the present-day insulators have been developed. The constructions are the invention of Mr. Louis Steinberger, one of the pioneers in

(Concluded on page 422.)



THE ELECTRICAL INDUSTRY AND THE YOUNG MAN

What Electricity Might Do for Him—What He Might Do for Electricity—A Little Article about His Work in Life

By JAMES H. COLLINS

One day, not long ago, a party of officials from Germany visited the main plant of the Westinghouse Electric & Manufacturing Company, at East Pittsburgh.

They walked down an aisle that seemed a mile long, past countless machines where the operators, a number of whom were girls, were winding insulated wire. They were solid serious Germans—real well-fattened husbands of the German *Hausfrau's* ideal. It was a long walk. The most serious member of the party plodded along without comment until the end of the aisle was reached. Then he turned to the guide and said:

"This is a big building."

They were taken around a corner and conducted back through another aisle of the same length, full of men and girls, and machinery, and again the serious visitor said nothing until the other end was reached. Then he declared:

"This is the biggest building I ever saw!"

Still the tour continued. They turned another corner, and walked down a third aisle, and now the serious German was getting winded. When the end was reached, he mopped his brow and exclaimed, in astonished conviction:

"Ach! This must be the biggest building in the world!"

Now, suppose a young fellow with his career all before him—say, a liberal arts sophomore, or high school senior—went through the same plant.

He, too, would be impressed chiefly by the size of the place, and very properly. For it is an immense works full of technical apparatus and processes. It is said to be the largest machine shop in the world. Nor is this all of Westinghouse, because the company has plants in other cities of the United States, and in Europe.

A young student would get the general impression that, if he were employed by Westinghouse, he would be connected with a very large concern indeed, with its thousands of workers, and millions of feet of floor space, and plants and output distributed all over the globe—surely a job to be proud of.

Still he might not see the path of opportunity open to him in the electrical industry.

The electrical business has been called the most forward-looking of our great industries. Every day more things happen in electricity than in any other line. More new devices are developed, more progress is made, and electrical service and products touch humanity more intimately.

The path is there, but it needs to be pointed out.

There was a time, certainly, when primitive man's whole idea of the application of power to work lay in carrying his few possessions around with him. And here begins the path of electrical opportunity. He lugged things around until it occurred to him to make pack animals carry them, and that led to the development of the drag or sled.

It was a great day when he cut his sled runners out of the trunk of the tree instead of from a limb. They turned round then instead of sliding, and much friction was eliminated.

For then the wheel was evolved, and civilization ever since has been pretty largely a matter of wheels—wheels and ways to turn them.

At first it was human muscle at the potter's wheel, and wind or water at the mill wheel, and horses on the chariot. These were the sources of power for centuries, and as long as they were retained the wheel that was turned never got very far from the power that turned it.

By and by, however, steam was utilized to turn wheels, and then came power transmission. Wheels could be hitched to wheels by shafts, gears, belts. One big wheel turned by a steam engine ran hundreds of lesser wheels, animating a whole factory.

Yet even with steam and the mechanical transmission of power, wheels were never made to turn each other at any considerable distance from the prime mover. It is true that cableways with wire ropes running on pulleys supported on piers were successful for distances of several miles—the cable street car was familiar only yesterday. It is true, also, that hydraulic and pneumatic transmission of power were in a very promising state of development yesterday, and are even utilized to-day under certain conditions.

But, suddenly, something happened to all the mechanical methods of power transmission.

Electricity came in between the big wheel at the prime mover and the little wheels at the other end, and the face of material civilization was changed almost in a day.

The superiority and wonder of electricity lie in its ability to turn wheels in ways never dreamed of with any mechanical system. It is the ideal and universal form of power transmission.

A copper wire is stretched from the place where power is made to where it is wanted for work. Old limitations of mechanical transmission are utterly disregarded. There are no shafts, belts, alignment. The wire can go up heights, down depths, around any maze of corners, and to distances that are restricted only by questions of economical operation. At one end of the wire the dynamo moves. And at the other end these mysterious waves that we call "electricity" turn a wheel in a motor—the power is available.

Besides turning wheels, electricity can be taken off the wire as light or heat, so it has a three-fold application.

Electricity is the most *flexible* form in which power can be had.

It may be generated in enormous quantities at the central station, by steam or water, and delivered in the tiniest driblets to anybody who wishes to purchase.

Without electricity, there could be no power in the average home.

But with electric current from a central station miles away, any home may have cheap power in any quantity. A penny's worth may be bought to sweep a room or chop the hash. Or it may be utilized as heat to iron the towels, or as light wherever needed. Electricity is available instantly, at any hour of the day or night, calls for no skilled attendant, is under perfect control, clean, safe, cheap, and delivers just enough power for the task.

This flexibility, economy, ease of control and cleanliness is just as great in the largest applications of industrial power—machines directly driven by electric motor make the modern factory cleaner, quieter, lighter, more efficient and better in every way.

* * *

The ambitious young man, leaving school and becoming part of the Westinghouse organization, would start at the very beginning of the path of electrical opportunity. But with energy and ambition he could soon travel far enough to see that it branched off in two directions.

First, there is the technical end of the business, engaged in developing and improving electrical apparatus.

Second, the distributing end, which is busy applying electricity to a wider and wider range of human service.

* * *

As the visitor walks through the Westinghouse works, he sees a bewildering variety of operations. Metal is being molded, forged, welded, bored, turned, pressed, spun, ground, polished. Wire is being wound in an infinity of ways, and sheets and plates of conducting metal built up to complicated patterns. There is a range from the gigantic to the microscopic, for in one plant big cranes handle parts for enormous turbo-generators, and in another the bearings of wattmeters are being fitted with tiny jewels. There is constant talk of armatures, commutators, condensers, resistances, alternators, rectifiers, single-phase, polyphase—a perfect Babel of technical terms.

In the end, however, it all comes down to about the same thing.

No matter what the contraption is called, or how large it may be, or how delicate, or complicated, it is likely to be just a special device for conducting current along a particular path so that it is made to accomplish a particular form of work.

Electrical development has been largely the development of ingenious paths for current. This development of new paths has been going on since Franklin provided his kite-string path for the lightning. Each year brings new subtilties, and every important new electrical installation calls for special refinements. So, the young man who finds the technical side of Westinghouse activities to his liking will have plenty of room to turn around in, and unlimited scope for the future.

Take the electric light, for instance. It began with the arc lamp. Close upon the arc lamp followed the incandescent bulb, in which current had to pass through a charcoal filament in a vacuum. Then followed improvements on the charcoal filament. Then the carbon was metallized—better yet. Then *metal* filaments of tungsten and tantalum were devised—and improvement after improvement on the metal filament. Better, and still better.

To-day the electrical industry is agog over the latest invention in incandescents—the metal filament in a bulb filled with nitrogen vapor, which gives out a glorious sunburst of several thousand candle-power, with a quality closely approximating daylight.

Another example is found in alternating current—peculiarly a Westinghouse development.

The first commercial electricity was direct current. That is, it flowed continuously from the generator in one direction along the wires. Direct current was extremely limited in scope, because it could be transmitted only a few miles. Its voltage, or pressure, was low—only 100 to 200 volts. So it had to be sent over heavy copper cables—in effect, a lazy flow in large volume, and not equal to much work after it had traveled any considerable distance. Even had direct current been effective on long transmission, the cost of the cables was a barrier against its practical development.

Alternating current, on the contrary, is divided into infinitesimal halves as it issues from the generator, each alternate half flowing in an opposite direction, with anywhere from a few to many thousands of alternations per second.

It can be sent at high voltage through small wires to great distances—at present practical transmission has reached a radius of 200 miles. Its pressure can be "boosted" up at any point along the line to maintain or accelerate the flow, and when the current arrives at the point where it is to be transformed into work its pressure can be "stepped down" to any required voltage.

The Westinghouse organization took up alternating current in its babyhood, when it was largely a scientific curiosity from Europe, neglected because nobody believed it could be made practical, and even regarded as dangerous.

First, a generator producing alternating current up to 1,000 volts, and capable of transmitting electricity to a distance of a mile or more, was built by the Westinghouse organization.

But how to use it for light and power was another matter, because such high pressure instantly destroyed any form of electric lamp, was unsafe inside a building, and would not turn the direct-current motors then in use.

The "transformer" of Gaulard and Gibbs, at that time a laboratory freak from Europe, was taken up by the Westinghouse organization, and perfected, so that current at 1,000 volts could be transmitted over considerable distances, and then reduced to normal lighting pressure. The first great installation of alternating current for lighting was made at the Chicago World's Fair in 1893, and was distinctly a Westinghouse triumph. To-day, transformers are made in all sizes, for all voltages and types of service, up to 150,000-volt giants for transmission lines.

And with the high-voltage transformer comes the condenser terminal, perfected by Westinghouse to lead high voltage currents safely into the transformer, and capable of handling over 150,000 volts and tested for 375,000 volts.

Motors, too, are paths devised to make electricity perform many sorts of work, from the little fractional horse-power motor that turns a dentist's drill up to the 156-ton Westinghouse electric locomotives used by the Pennsylvania Railroad. And to the making of new types there is no end.

The mercury rectifier is another path for current, and a mighty interesting one. It is a large glass bulb, filled with mercury vapor, and in use looks just like the familiar Cooper Hewitt lamp used for lighting. It gives the same greenish-bluish light—and is, in fact, a modification of that lamp. The mercury rectifier takes an alternating current at two poles, splits the two halves, and sends them out, flowing in the same direction, at a third pole, and thus converts alternating current into the direct current necessary to charge the storage batteries of an electric automobile.

The little electric flatiron now coming into such wide use for housework is a particular path for electric current, its heating element being designed to transform electricity into heat with the highest economy. So are the other heating devices for household use, such as the electric stove, electric radiator, electric toaster, coffee percolator, chafing dish and so forth.

So are the industrial heating devices found in every manufacturing plant—the soldering irons, melting pots, welding devices, vulcanizers, sterilizers, heaters and many other conveniences for operation by electric current. So are the electric meters, the spark coils and vibrators, the controllers and converters, and almost every other form of electrical apparatus—paths—all paths.

* * *

The other great division of the Westinghouse organization is that which distributes this infinitely varied product to the world.

Not long ago, an engineer, visiting East Pittsburgh, found that Westinghouse electric generators aggregating half a million horse-power were under construction, and he further learned that the average monthly output of the Westinghouse Electric Company approximates one-half million horse-power.

In 1890, census returns showed that the electrical energy used in our factories amounted to less than sixteen thousand horse-power. To-day, the aggregate is fully five million horse-power.

In 1890, our street railways used a few hundred thousand horse-power of electrical energy. To-day, their total exceeds five million horse-power.

In 1890, the central station industry was a struggling infant. To-day, it is employing capital aggregating two and a half billion dollars, and one of the best banking

authorities in the United States says it can normally develop at the rate of four hundred million dollars yearly for the next five years.

Figures of this sort could be strung out to any extent. A few big items are given here to indicate the scope of the market for electrical products, and to make clear to the young man who might find the distributing part of the Westinghouse organization most to his liking, what a field lies open to him.

From the days when alternating current was being developed by the Westinghouse organization, this "wholesale" side of the demand has been fascinating to the kind of young man who likes the human and the technical blended in his work.

From one industry after another has come up problem after problem, to be solved by study of the conditions and original designing of apparatus. And the Westinghouse organization has not waited for the problems to come, but has gone out into many industries and dug them up on its own initiative.

Special generating, transmission and motor equipment have been made to solve these problems, both in alternating and direct current apparatus.

Twenty years ago the 1,000-horse-power Westinghouse generators built for the Chicago World's Fair were regarded as giants. But to-day, single generating units of 45,000 horse-power are being built by the Westinghouse Company for central station and electric railway service, and promise to become quite common by reason of their great economy in producing power. It is largely a matter of developing the market for such quantities of power—for a single generator of that capacity would run all the men's clothing factories in the United States.

In steel mills, motors have been adapted to the individual driving of every machine, and made fireproof to withstand the hard service.

In mine and other service, they have been made water-proof.

In the textile industry, they have been modified in many ways to meet peculiar demands in spinning and weaving.

In railway service, they have been built to give high speeds and great tractive power, coupled with maximum strength and minimum weight.

In machine building, printing, shoemaking, construction and many other industries they are provided in every conceivable size and type, for individual or group driving of machinery, making possible the purchase of power at the most reasonable prices, its use with the least loss, the utmost convenience in running at any hour of the day or night, and ease of measuring power consumption of individual machines or departments.

And every day this wholesale demand for electrical apparatus grows, not only in volume, but in breadth and interest.

As an illustration of that, the enormous field in transportation may be touched upon.

The electrification of our railroads is pretty certain to come about during the present generation. Electrification of suburban divisions running out of the largest cities has demonstrated the immense economy of the new power, and this is being followed up by the electrification of mountain divisions where present operating costs are high. Water power is being developed on such a scale as to provide electricity for railroads everywhere. Trolley systems are being linked up into true railroad systems. Electric power is proving to be the most economical means for developing new territory, giving service to communities beyond the economic reach of steam roads. Electrification of the steam roads is no longer a technical matter, but one of finance and management. Even in water transportation, the electrical propulsion of ships promises to be the most economical means of utilizing the high speeds and low costs of steam turbines.

On top of this there is an enormous "retail" demand—and the still more enormous untouched retail field, which must be turned into consumers for the vast amount of current that will be produced by the great electric power plants now just coming into operation and still building.

To market such volumes of power, electricity must be extended not only to factories, but to homes. To put electricity into the homes calls for the highest type of educational selling. Apparatus is being perfected daily by the manufacturing end of the electrical business. The electric flatiron, washing machine, heating and cooling devices and so forth are ready for the public. Electricity is beyond question the ultimate solution of the servant problem.

The carbon filament lamp was standard yesterday. Originally, it consumed so much current that it was restricted to well-to-do homes. Then its efficiency was increased, and it came in reach of a wider public. To-day, the new nitrogen lamp is cutting current consumption down to as little as one-twelfth the consumption of the old carbon filament lamp, and the use of electric light has been made universal, in theory—with the practice delayed only a little. Small household motors have been perfected in the same way. Likewise household heating devices—and electric cooking for many homes is a possibility of the immediate future.

In 1880, the country's whole output of electrical apparatus was worth only two and a half million dollars. In 1890, it had grown to only twenty millions. To-day, a million dollars' worth of electrical apparatus is produced every day in the year.

Each development of apparatus, each lowering of costs, extends the field for putting electricity into more homes, in theory.

But, as a practical proposition, people must be taught and persuaded. They must be shown how to use those electrical conveniences which are already within their means, and how a larger capital investment in apparatus will secure lower cost of living and greater comfort.

So the popularization of electricity calls for the highest kind of selling effort. Along with the potential home demand, which increases far more rapidly than selling effort can keep pace with it, there is the small industrial demand from manufacturers, merchants and business concerns whose requirements of a few motors and electrical tools do not bring them into the wholesale class.

To cultivate this vast retail field is not the work of the central station alone, though the latter, it is true, sells the current. It calls for the close co-operation of the electrical manufacturer, and is a field in which the Westinghouse organization has always been active, making studies, developing sales methods and working with the distributors and users of electricity.

If all the demand from homes and small industrial concerns were suddenly to cease, there would still be a lifetime of work for hundreds of young men in taking care of the new retail demand just rising—that for electricity on the farm. This is coming, surely and quickly, with the electrification of the railroads, the development of water-powers and the extension of central station transmission systems into country districts.

Now, what can the electrical industry do for the young man?

And what can he do for the electrical industry?

It is usually assumed that a business so largely technical needs none but engineers, electricians and men of technical training.

But that is a very narrow view—quite mistaken.

To-day, industry is being humanized, both in its relations with the public and with its own workers. New standards are being set and new ideals worked out—ideals that would have been scouted as theoretical and altruistic five years ago.

The electrical industry always needs the young man of general education, broad sympathies, clean life, energy, ambition, open-mindedness, the faculty for getting on with other men, the ability to look ahead and visualize to-morrow, the man who can teach and inspire others while he learns and grows himself.

Electricity's need for young men is constant, in every department of the industry, both production and distribution.

Knowledge is an advantage, whether technical or general, and at the same time is only something to start from.

The young man himself is chiefly a potentiality, to be introduced into the industry somewhere, given specific tasks, tried, gauged, placed, developed and advanced according to his individual ability. If he has the energy and the ambition, the path of electrical opportunity is open to him. If he is not well placed at one kind of work, he can be tried at others—the field is unlimited in its scope and diversity. If he can grow, his development will mean the development of the industry in some detail or direction, and no matter how fast he may be capable of advancing, there is certain to be plenty of room ahead of him, always.

Electricity is essentially a young man's business.

It is alive all over, both in ideas and in its physical organization.

It is a business of to-day and to-morrow—not yesterday.

Business in general is very apt to be grounded on personal policy. The opinions and methods and energy of a few leaders prevail. Time and change bring habit and tradition. Conservatism creeps in, narrowing the outlook and limiting the possibilities.

But the electrical industry is grounded on scientific truth. It grows on a solid basis of experiment and research. Being built on actualities, and always subject to correction of natural laws, there is no room for the entrance of personal rule, prejudices, habits, traditions, the limitations of mere opinion.

As a young man's business it is typified in the Westinghouse organization. From the first, Westinghouse has been an organization of young men, alive, looking into to-morrow, trained down to the minute. It is a young man's organization to-day, and always will be in spirit and methods, no matter what its age may happen to be in years.—*Advertisement.*

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Inquiry No. 9371. Information wanted where one could buy or have made to order machine to be used for making solid back brushes.

Inquiry No. 9372. Wanted the name and address of manufacturers of a collapsible box about 12 inches square. It must be strongly made to withstand rough usage in transit.

Analyzing the Human Singing Voice

(Concluded from page 407.)

partial tone (fundamental and overtones) separately and all of them collectively," observes Dr. Muckey. "The first thing we notice is that the waves vary in length, the wave in the lowest line of the voice-tone photograph being longer than that in any other line, and the one in the second line being just half of that in the first. We find that the tone represented by the second line is the octave of that represented in the first line.

"The waves gradually diminish in length as we go up in the series and the pitch of the tone rises. This proves that the length of the wave determines the pitch of the tone. Then we observe that the waves vary in height, the waves in the first line being highest. They gradually diminish in height as we go up in the series.

"Our experiments have demonstrated that the fundamental tone, or the one with the highest wave, has the greatest carrying-power, and that the other waves, representing the overtones, diminish in direct proportion to the lessening of the height. Thus we have intensity and carrying-power equal to the height of the wave.

"Our experiments have shown, also, that any change in the number and relative intensities of the partial tones makes a corresponding change in the quality of the tone, and, so, we have quality dependent absolutely upon the number and relative intensities of the partial tones. If we take away one partial tone it changes the quality of the tone as a whole, and if we take away several it makes a very decided change in the quality. Similarly, if we change the intensity of any one or more of the partial tones, it makes a corresponding change in the quality."

He adds, in summing up the results of his two decades of labor with Prof. Hallock:

"Resonance has been the keynote of our work. It has been at once our tool, and the object wherefor we have striven. For our purpose resonance may be defined as the reinforcement of a tone by a quantity of more or less confined air, the inherent rate of vibration of which is identical with that of the tone reinforced. Such a quantity of air receiving successive impulses from the vibrating source, or object, comes into vibration itself, thus giving to the surrounding air a much greater amplitude of vibration and consequently greater intensity and carrying-power to the tone."

Several improvements in the manometric flame tone analyzer have been devised by Prof. Hallock. A simpler construction and the elimination of much of the rubber tubing of the Koenig-Helmholz apparatus have brought it to a stage where it not only registers more satisfactorily the tone-production of the voice, but begins to fulfill the long-felt want of a recorder of the tonal quality of musical instruments of every character, and especially of those of the string family—the pianoforte, the violin, the 'cello, etc.

Fire Protection for Ocean Liners

(Concluded from page 416.)

been closed, in accordance with the best actual practice, by fireproof glass doors designed to withstand a temperature of upward of 1,000 degrees.

In addition to the iron bulkheads thus lined with fireproof coatings, a new type of fire-resisting transverse walls has been fitted at regular intervals, the design of which is another outcome of the above tests. These walls are likewise provided with fireproof doors. Special care has been bestowed on the insulation of the staircases. The main staircase, over which passes most of the passenger traffic, has an entirely fireproof lining, so that each vestibule constitutes, as it were, a smoke-proof lock. Fireproof elegant glass doors insure an easy access to the staircases. This scheme, which complies with the very stringent regulations of the German police authorities, for the fireproofing of department stores, warrants, according to any human prevision, a narrow localization of any conflagration and a safe escape from the smoke and fire.

In the rear part of the promenade deck, there is a guard-house and central station for all fire alarms. Five professional superintendents, trained at the Kiel Fire Brigade, under the guidance of a responsible chief officer, have been intrusted with a well-organized watching and patrolling service and with the upkeep of all fire alarms and signaling apparatus on board. There are in all 450 fire alarms converging toward an annunciator board in the guard room. These electrical fire alarms, which are arranged to work automatically at a given temperature, are installed not only in the cabins and saloons, but, with wise foresight, in the less frequently used holds, refrigerating chambers, post offices and storage rooms.

As regards the rooms destined for the crew, another step was taken to insure even greater safety against fire, by the installation of automatic sprinklers. There are 800 sprinklers of this kind aboard the "Imperator." As soon as some of them are actuated automatically, the pressure in the pipes decreases, thus operating an electrical alarm at the central station. The extinguisher pipes are in their turn connected directly with the general sea-water conduits, thus providing always the water required to produce the necessary head and dispensing with any special pump in the event of an outbreak.

Reference should also be made to the Rich apparatus, arranged to work with carbonic acid instead of with steam as heretofore, and to the new Draeger apparatus, both of which, it will be recalled, won the Scientific American Safety Medal. These, in conjunction with the customary König smoke helmets, are bound to prove most helpful in the case of smoke production.

Evolution of the High-tension Insulator

(Concluded from page 418.)

the development of high-tension insulation, he being the first to make successfully, and on a commercial basis, high-potential insulators from a material other than glass or porcelain. It will be observed that the suspension members are imbedded in the insulator and interlaced, so that should the insulating material be shattered, the line would still be supported by a chain made up of the suspension members. Owing to the swivel form of the terminal, two or more units may be connected or disconnected in the fraction of a minute, no special tool being required to operate the connecting nut, as a plain wrench, a nail or even a piece of wire may be employed. The clamp, which is shown suspended from one of the insulators, is formed with flared ends to prevent crystallization and possible breaking of the conductor as it is swung back and forth by the wind. The disk or suspended type of insulator has become so standardized that it is used on all lines operating above 50,000 volts, and even on lines of 44,000 volts in some instances. The 10-inch disk "strain" and "suspension" insulators here illustrated have been tested to show a puncture value in oil of 150,000 volts, and of 100,000 volts when tested to dry arc value. The rain arc value is 55,000 volts, line voltage 25,000 volts and mechanical value 20,000 pounds, while the weight is not 11 pounds.

A New German Life-saving Costume was exhibited at the International Conference on the Safety of Life at Sea, in London, by its inventor, Paul Raschke, a tailor of Breslau. It is made of a composition of aluminium and rubber, with a padded belt around the body under the arms. The outfit includes a pouch intended to contain supplies of food and drink. The inventor demonstrated his apparatus in the Thames. He adjusted the suit in less than three minutes, jumped in the river, where the costume kept him afloat, and propelled himself in any desired direction with a pair of paddles. Taking a cigar from his pouch, he lighted it and smoked most of the time he remained in the water, about 45 minutes. He claimed that the suit kept him comfortably warm in the cold water.

He Mops in Misery Without B. V. D.

A TYPICAL summer day—a typical office scene—a round of smiles at the mingled *discomfort* and *discomfiture* of the man who hasn't found out that B. V. D. is *"the first aid"* to coolness. *You,* of course, have B. V. D. on or ready to put on. If not, march to the nearest store and *get it.*

For your own welfare, fix this label firmly in your mind and make the salesman *show* it to you. If he can't or won't, *walk out!* On every B. V. D. Undergarment is sewed

This Red Woven Label

MADE FOR THE

B.V.D.

BEST RETAIL TRADE

(Trade Mark Reg. U. S. Pat. Off. and Foreign Countries.)

B. V. D. Coat Cut Undershirts and Knee Length Drawers, 50c., 75c., $1.00 and $1.50 the Garment.

B. V. D. Union Suits (Pat. U. S. A. 4-30-07.) $1.00, $1.50, $2.00, $3.00 and $5.00 the Suit.

The B. V. D. Company, New York.

London Selling Agency: 66, Aldermanbury, E. C.

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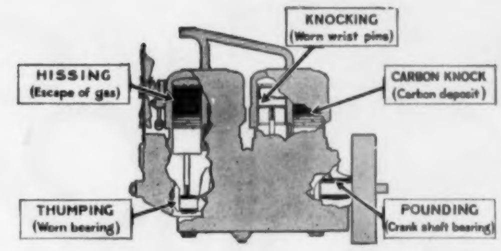

NOISE

The motor's complaint against incorrect oil

If your motor makes some unusual sound, stop your car. Investigate.

Noise frequently means unnecessary friction—the direct result of incorrect lubrication.

Common noises are:

"Thumping." A dull thump at each revolution of the main shaft indicates worn main or connecting rod bearings. This trouble is hastened by oil of low *quality* or incorrect *body*—will finally result in badly worn bearings and knocking.

"Knocking." This may be due to loose wrist-pins. It may be due to badly worn bearings or bushings which should be refitted or replaced. Incorrect lubrication will cause both of these troubles.

"Carbon Knock." A sharp muffled ring, at ignition, indicating excessive carbon deposit usually caused by oil of low *quality* or incorrect *body.*

"Pounding." Due to engine laboring under overload. Lubrication plays no part in this trouble.

"Hissing." This is frequently due to heavy scoring of cylinder walls. It is most often brought on by inefficient lubrication.

* * * *

There is only one insurance against the results of incorrect lubrication. That is the use of oil of the highest *quality* which is correct in *body* for your type of motor.

You can secure this oil by referring to the Lubricating Chart which is partially shown at the right. For a number of years this Chart has been a standard guide to correct lubrication.

It represents the professional advice of the Vacuum Oil Company—the recognized world leaders in scientific lubrication.

Our complete Chart will be mailed to any motorist on request.

We will also send on request a pamphlet on the Construction, Operation and Lubrication of Automobile Engines. It describes in detail the common engine troubles and gives their causes and remedies.

It is safest to buy Gargoyle Mobiloils, in original barrels, half-barrels and sealed five and one-gallon cans. See that the red Gargoyle, our mark of manufacture, is on the container.

The various grades of Gargoyle Mobiloils, purified to remove free carbon, are:

Gargoyle Mobiloil "A,"
Gargoyle Mobiloil "B,"
Gargoyle Mobiloil "E,"
Gargoyle Mobiloil "Arctic."

They can be secured from reliable garages, automobile supply houses, hardware stores, and others who supply lubricants.

For information, kindly address any inquiry to our nearest office. The city address will be sufficient.

Correct Lubrication

Explanation: In the schedule, the letter opposite the car indicates the grade of Gargoyle Mobiloil that should be used. For example: "A" means "Gargoyle Mobiloil A." "Arc" means "Gargoyle Mobiloil Arctic." For all electric vehicles use Gargoyle Mobiloil "A." The recommendations cover all models of both pleasure and commercial vehicles unless otherwise noted.

MODEL OF	1910		1911		1912		1913		1914	
CARS	Summer	Winter	Summer	Winter	Summer	Winter	Summer	Winter	Summer	Winter
Abbott Detroit	A	Arc.	A	Arc.	A	Arc.	A	Arc.	Arc.	Arc.
Alco	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.		
American	A	Arc.	A	Arc.	A	Arc.	A	Arc.	A	Arc.
Autocar (2 cyl.)	A	Arc.	A	Arc.	A	Arc.	A	Arc.	A	Arc.
" (4 cyl.)	A	E	A	Arc.	A	Arc.				
Avery	A	E	A	E	A	A	A	A	A	A
" (Model C)									Arc.	Arc.
Buick (2 cyl.)	A	A	A	A	A	A	A	A		
" (4 cyl.)	Arc.	Arc.	A	Arc.	A	Arc.	A	Arc.	A	Arc.
" (6 cyl.)									A	Arc.
Cadillac	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.
Cartercar	A	E	A	E	A	E	A	E	Arc.	Arc.
" Com'l	A	E	A	Arc.	A	Arc.	A	Arc.		
Case			A	A	A	Arc.	A	Arc.	A	Arc.
Chalmers	Arc.	Arc.	A	Arc.	Arc.	Arc.	Arc.	Arc.	A	A
Chase (air)	B	B	B	B	B	B	B	B	B	B
" (water)									Arc.	Arc.
Cole	Arc.	Arc.	A	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.
Delaunay-Belleville	B	A	B	A	B	A	B	A	B	A
E. M. F.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.				
Empire	A	Arc.	A	Arc.	A	Arc.	Arc.	Arc.	Arc.	Arc.
Fiat	A	A	B	A	A	A	B	A	B	A
Flanders	E	E	E	E	Arc.	Arc.				
" (6 cyl.)							Arc.	Arc.		
Ford	A	Arc.	E	E	E	E	E	E	E	E
Franklin	B	Arc.	A	Arc.	A	Arc.	A	Arc.	A	A
" Com'l	B	A	B	A	A	Arc.	A	Arc.		
G. M. C. Truck					Arc.	Arc.	A	Arc.	A	Arc.
Havers			A	Arc.	A	Arc.	A	Arc.	A	A
" (Model 6-40)									Arc.	Arc.
Haynes	A	E	A	Arc.	A	Arc.	A	Arc.	A	Arc.
Hudson	Arc.	Arc.	A	Arc.	A	Arc.	A	Arc.	A	Arc.
Hupmobile (Model 20)	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.		
" (Model 32)							A	Arc.	A	Arc.
I. H. C. (air)							B	A	B	A
" (water)							A	A	A	A
International	B	A	B	B	B	A				
Interstate	A	E	A	Arc.	A	Arc.	A	Arc.		
Jackson (2 cyl.)	A	A								
" (4 cyl.)	A	Arc.	A	Arc.	A	Arc.	A	Arc.	Arc.	Arc.
" (6 cyl.)									Arc.	Arc.
Jeffery									A	A
" Com'l					Arc.	Arc.	Arc.	Arc.	Arc.	Arc.
Kelly			Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	A	A
King			A	E	A	E	A	E	A	A
" Com'l									Arc.	Arc.
Kissel Kar	A	E	A	Arc.	A	Arc.	A	Arc.	Arc.	Arc.
" " Com'l			Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.
" " (Model 48)									A	A
Kline Kar	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	A	Arc.
Knox	B	A	B	A	B	A	B	A	B	A
Krit	A	A	A	A	A	A	A	A	A	A
Locomobile	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	E	E
Lozier	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	A	Arc.
Mack	A	E	A	E	E	E	E	E	A	E
" (Model [illegible])							A	A	A	A
Marion	A	E	A	E	A	Arc.	A	Arc.	Arc.	Arc.
Marmon	A	E	A	Arc.	A	Arc.	A	Arc.	A	Arc.
Maxwell (2 cyl.)	E	E	E	E	B	E				
" (4 cyl.)	E	E	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.
" (6 cyl.)							Arc.	Arc.	Arc.	Arc.
Mercer	A	Arc.	A	Arc.	A	Arc.	A	Arc.	A	Arc.
Mitchell	Arc.	Arc.	A	Arc.	A	Arc.	A	Arc.	A	Arc.
Moline	A	E	A	Arc.	A	Arc.	A	Arc.		
Moline Knight									A	A
Moon (4 cyl.)	A	E	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	A	Arc.
" (6 cyl.)									Arc.	Arc.
National	A	A	A	A	A	A	A	A	A	A
Oakland	A	E	A	Arc.	A	Arc.	A	Arc.	Arc.	Arc.
Oldsmobile	A	E	A	Arc.	A	Arc.	Arc.	Arc.	Arc.	Arc.
Overland	A	E	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.
Packard	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	A	Arc.
Paige Detroit	E	E	A	Arc.	A	E	A	E	A	A
Pathfinder							A	Arc.	Arc.	Arc.
Peerless	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.
Pierce Arrow	Arc.	Arc.	A	Arc.	A	Arc.	Arc.	Arc.	Arc.	Arc.
" " Com'l			Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.
Pope Hartford	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.
Premier	A	Arc.	A	Arc.	A	Arc.	A	Arc.	A	Arc.
Rambler	A	A	A	Arc.	Arc.	Arc.	Arc.	Arc.		
Regal	A	E	A	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.
Renault	A	Arc.	A	Arc.	A	Arc.	A	Arc.	A	Arc.
Reo	A	E	A	Arc.	A	Arc.	A	Arc.	A	Arc.
Saxon									E	E
S. G. V.			B	Arc.	B	Arc.	B	Arc.	A	Arc.
Selden	A	E	A	E	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.
Simplex	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.
Speedwell	Arc.	Arc.	A	Arc.	A	Arc.	Arc.	Arc.	Arc.	Arc.
" Mead							A	Arc.	B	A
Stearns	Arc.	Arc.	A	Arc.	A	Arc.				
" Knight					A	A	A	A	B	A
Stevens Duryea	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.
Stoddard-Dayton	Arc.	Arc.	A	A	A	A	A	A		
" " Knight					A	A	A	A		
Studebaker	E	E	A	Arc.	Arc.	Arc.	A	Arc.	A	Arc.
Stutz					Arc.	Arc.	Arc.	Arc.	A	A
Velie (4 cyl.)	A	E	A	Arc.	A	Arc.	A	Arc.	A	Arc.
" (6 cyl.)									Arc.	Arc.
Walter	A	E	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.
White	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.
Winton	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.

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SIX

$1575

Full Floating Rear Axle
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Electrically Lighted

This Car Against Any Car—Let Us Prove It

With every sense alert, try, as you ride in the Studebaker SIX, to imagine some one particular in which its riding qualities might be improved.

Try to recall some previous ride in a heavier, costlier car, which seemed to you, then, the uttermost in luxury.

Superfluous weight does, sometimes, make for steadiness, there's no doubt about that — see, now, how this light, strong car attains the same identical result in steadiness and roadability with none of the disadvantages of excess weight.

Take the wheel and see if you ever felt that you had at your command a greater flood of pent-up flexible power.

Test out that flexibility — see how instantaneously obedient this docile engine actually is to the touch of your finger-tips.

Put it through its paces—face it with obstacles and difficulties—and see if it does not respond in every case like the thoroughbred it is.

Demonstration — demonstration against any car, and every car — demonstration drastic down to the smallest detail — that's what Studebaker asks, without fear, from you, for this splendid Studebaker SIX.

F. O. B. Detroit

FOUR Touring Car	$1050
SIX Touring Car	$1575
SIX Landau-Roadster	$1800
SIX Sedan	$2250
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Six-Passenger "SIX"	$1550

F. O. B. Walkerville, Canada

FOUR Touring Car	$1375
SIX Touring Car	$1975
SIX Landau-Roadster	$2350
SIX Sedan	$2950

Canadian Factories
Walkerville, Ont.

Descriptive Data

Studebaker FOUR and SIX motors are cast enbloc. They are of the modern long-stroke type, giving the highest possible efficiency in power and gallon-mileage.

Each Studebaker car has a full complement of adjustable Timken roller bearings—a pre-eminent anti-friction device.

Built complete in the vast Studebaker shops, each Studebaker unit fits with perfect alignment into the synchronized Studebaker chassis. Even the tops and the Jiffy curtains of Studebaker cars are built by Studebaker workmen.

Other points of excellence included in each Studebaker FOUR or SIX—

Full floating rear axle; the Studebaker-Wagner electrical system; gasoline tank in cowl with direct line to dash-adjusted carburetor; enclosed valves, quiet and retaining accurate adjustment; running boards clear of all equipment; extra rim, mounted at the rear; special quality electric lamps; electrically lighted dash equipment with lubrication sight feed, battery tell-tale and Stewart-Warner magnetic speedometer.

Studebaker, Detroit